# Central Coast Juvenile Herring Survey, August 2009

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Nanaimo, British Columbia
V9T 6N7

2010

**Canadian Manuscript Report of Fisheries and Aquatic Sciences 2939**

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by

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Cat. No. 97-4/2939E ISSN 0706-6473

Correct citation for this publication:

Thompson, M., Fort, C., and Therriault, T.W. 2010. Central Coast juvenile herring survey, August 2009. Can. Manuscr. Rep. Fish. Aquat. Sci. 2939: vi + 54 p.

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## ABSTRACT

Thompson, M., Fort, C., and Therriault, T.W. 2010. Central Coast juvenile herring survey, August 2009. Can. Manuscr. Rep. Fish. Aquat. Sci. 2939: vi + 54 p.

In 2009, a Central Coast juvenile herring survey was conducted from August 9-21. Sixty sets were made at 13 locations within Statistical Management Areas 6, 7, 8 and 9. The study area extended from Meyers Passage in the north to Rivers Inlet in the south. The survey serves to address information gaps on the distribution, abundance, size and feeding habits of juvenile herring in these nearshore, northern waters.

Fourteen species of fish were identified in all purse seine catches with Pacific herring (*Clupea pallasi*) being the most frequently encountered species. A total of 4669 herring were measured resulting in a length frequency distribution that was distinctly bimodal representing age-0+ and age-1+ fish. Age-0+, age-1+, and age-2+ or older herring occurred in 65.0, 80.0, and 40.0% of the sets, respectively. Two oblique plankton tows were performed at each of the 13 locations resulting in a total of 26 tows during the survey. *Acartia longimeres*, larval euphausiids and *Pseudocalanus sp.* occurred in all samples, and *Acartia longimeres* and *Pseudocalanus sp.* showed up in the largest biomass. Twenty-six CTD casts also were performed during the survey to document oceanographic conditions.

# RÉSUMÉ

Thompson, M., Fort, C., and Therriault, T.W. 2010. Central Coast juvenile herring survey, August 2009. Can. Manuscr. Rep. Fish. Aquat. Sci. 2939: vi + 54 p.

En 2009, une campagne de recensement portant sur les stocks de harengs juvéniles de la partie centrale de la côte a été effectuée entre le 9 et le 21 août. Au total, 60 traits de senne ont été réalisés à 13 endroits différents des zones de gestion statistiques 6, 7, 8 et 9. Le secteur couvert s'étendait du passage Meyers, au nord, à l'inlet Rivers, au sud. Le relevé vise à combler les lacunes dans les données sur la répartition, l'abondance, la taille et les habitudes alimentaires des harengs juvéniles dans ces eaux littorales du nord.

En tout, 14 espèces de poissons ont été dénombrées dans les ponctions effectuées, le hareng du Pacifique (*Clupea pallasi*) étant l'espèce la plus souvent représentée, et 4669 harengs ont été mesurés. Les résultats indiquent une distribution nettement bimodale e la fréquence des longueurs, représentant la prédominance des individus d'âge 0+ et d'âge 1+. Les harengs des classes d'âge 0+, 1+ et 2+ correspondaient respectivement à 65,0 , 80,0 e[illegible]0 0 % des poissons récoltés dans les traits. Deux traits obliques de filets à plancton ont [illegible] effectués à chacun des 13 endroits, pour un total de 26 traits. *Acartia longimeres*, larvaire euphausiids et des *Pseudocalanus* sp. étaient présents dans tous les échantillons, alors que *Acartia longimeres* et des *Pseudocalanus* sp. constituaient la biomasse la plus élevée. Enfin, 26 profils verticaux de STD ont été réalisés en concomitance avec les opérations de recensement, pour documenter les conditions océanographiques.

## INTRODUCTION

Pacific herring (*Clupea pallasi*) are an important commercial species and a vital forage fish for many marine mammals, birds and other fish in British Columbia's coastal waters. Herring spawn principally on marine vegetation in the subtidal and upper intertidal zone between February and June, with peak spawning between March and April (Humphreys and Hourston 1978). Larvae hatch in two to three weeks, and disperse with surface currents, metamorphosing into juvenile herring at a length of ~25mm (Hourston and Haegele 1980). Juvenile herring consist of two distinct age classes, age-0+ and age-1+, with recruitment for this species occurring at age 3 when they join the sexually mature spawning population (Hay and McCarter 1999). During daylight hours, juvenile herring congregate in schools, occasionally forming mixed aggregates with other pelagic species, close to shore near the bottom (Haegele 1997). At dusk, these fish migrate into surface waters to feed on plankton. During this time they are vulnerable to purse seine gear.

Relatively little is known about the distribution, abundance, size and feeding habits of juvenile herring in the Central Coast of British Columbia (Figure 1). In 2002-2004, and 2007-2009 juvenile herring surveys were designed to address information gaps and learn about the general biology of herring in this northern geographical area. The survey used an ecosystem based approach to biological sampling. Therefore, in addition to juvenile herring, all other fish species were retained for analyses. Also, plankton samples and oceanographic data samples were collected. This approach will potentially provide a better understanding of the role and relationships juvenile herring have in Central Coast waters, and may provide an empirical forecast of recruitment to the herring roe fishery based on relative juvenile abundance (Schweigert et. al. 2009).

## METHODS

In 2009, the Central Coast juvenile herring survey was conducted from August 9-21. Sixty sets were made at 13 locations within Statistical Management Areas 6, 7, 8, and 9 (Table 1). The study area extended from Meyers Passage in the north to Rivers Inlet in the south (Figures 2 and 3). The 2009 set locations followed the 2007 survey (Thompson and Therriault 2009). The sampling sites originally were chosen based on known historical herring spawning sites, and represent both nearshore and open water habitats (Haegele and Armstrong 2003).

### Fish Sampling

The 12 m, aluminum-hulled Fisheries Research Vessel *Walker Rock* was used for all fishing events. A 183 m long and 27 m deep purse seine net of knotless web, resulting in an area fished of ~2665 $m^2$, was used for all fishing events. The body of the net had 46 m of 22.2 mm mesh at the tow end followed by 91 m of 19.0 mm mesh, and the bunt end was 46 m of 9.5 mm mesh. The net fished to a depth of 10 m, and was able to retain fish greater than 20 mm in length. All sets were made after dusk when herring are feeding

near the surface. All sets were made "blind" at predetermined set locations. Five sets were completed per night for all locations. Four sets were cancelled in Kwakshua channel (set code 2) due to the onset of high winds and one set was cancelled in Kitasu Bay (set code 7) due to high winds. For most sets, it was possible to land the entire catch for biological sampling. On occasion, it was not practical to land a large set in its entirety, so sub-sampling was necessary. When sub-sampling was required, a herring bucket was filled with randomly selected fish and retained for biological sampling. Several dipnet samples from various parts of the net (catch) would be used to make up the random sub-sample. The remainder of the set was released over the corkline, its size estimated as the number of buckets released. The number of herring caught in each set was determined by multiplying the sub-sample herring weight and number by the number of estimated buckets released (total catch). The number of other species caught in the sub-sample was determined in the same manner (Table 2). All fish retained for sampling were weighed, bagged and preserved in a 3.7 % seawater formalin solution, with the exception of large predator species (e.g., adult salmon, dogfish and mackerel). These fish were individually weighed and measured in the field. Retained samples were taken back to the Pacific Biological Station for laboratory analysis.

From each set, 100 or more herring from each represented age-class and all other fish species caught were identified, weighed and measured. If the set contained less than 200 herring, then all herring were weighed and measured. Consistent with standard practices, herring were measured to standard length; salmon to fork length; dogfish, hake and pollock to total length. All other fish species were measured to standard length.

**Plankton Sampling**

Twenty-six stepped oblique plankton tows were performed during the survey (Figures 4 and 5). Two plankton samples were taken from each location, one sample "nearshore" and the other "offshore or channel". The tows were completed after dusk and immediately before fishing events. Dual 19 cm diameter bongo nets with 350 µm mesh were used for sampling, resulting in 'left' and 'right' bongo plankton samples (only left samples were processed). The bongos were lowered to 20m and raised by an electric winch at a rate of 1m every 15 seconds. A General Oceanics® 2030R model flowmeter was attached to the left bongo to determine the volume of seawater filtered. Volume filtered was calculated using the following equation (McCarter and Hay 2002):

$$\mathbf{V = (A \cdot F \cdot K) / 999{,}999}$$

Where:

**V** = volume of water filtered through the plankton net ($m^3$)
**A** = area of net opening (0.02835 $m^2$)
**F** = number of revolutions recorded by the flow meter (m)
**K** = standard speed rotor constant for 7cm rotor (26,873)

Upon retrieval, the bongo nets were washed with a high pressure deck hose, and the samples preserved in 3.7 % seawater formalin.

In the laboratory, a volumetric splitter was used to reduce the sample size to a point where organisms could be conveniently counted and identified in a counting tray using a stereo microscope under 30X magnification. Sample splitting continued until a target size of roughly 300 organisms was reached (Thompson et al. 2003).

When possible, plankters were identified to the lowest taxonomic level. Copepods were identified to species. Densities for all plankters were determined and expressed as plankters $\cdot$ $m^{-3}$.

**CTD Sampling**

To characterize oceanographic conditions in the surveyed area, a total of 26 CTD (conductivity – temperature – density) casts were made using a RBR XR-620 (Figures 4 and 5). One CTD cast was performed at each location before plankton sampling. The CTD unit was weighted and lowered over the side of the vessel to within a few meters of the bottom to give the largest water profile possible. Descent rate of the CTD is close to 1 m/sec. Data was subsequently downloaded to a laptop computer from the CTD unit each evening.

## RESULTS

Sixty sets were made during the 2009 survey; five in section 101 (Rivers Inlet), five in section 091 (Fish Egg Inlet), one in section 085 (Kwakshua Channel), five in section 076 (Kildidt Sound), nine in section 067 (Kitasu Bay and Meyers Passage), five in section 077 (East Higgins Pass), ten in section 072 (Powell Anchorage and Spiller Channel), five in section 073 (Hunter Channel), five in section 084 (Burke Channel), and five in section 081 (Dean Channel). All set locations correspond to set locations used in the 2007 Central Coast survey (Figures 2 and 3, Table 1). One set was cancelled in Kitasu Bay due to high winds and all four sets were lost in Kwakshua channel due to high winds.

Fourteen species of fish and one invertebrate species were identified in the purse seine catches. The most frequently encountered species (>25% occurrence) included: Pacific herring, Pacific sardine and capelin (Tables 2 and 3).

**Herring**

A total of 4669 herring were measured resulting in a bimodal length-frequency distribution. Based on this length-frequency distribution (Figure 6), the length designations for the two juvenile herring age-classes are:
0+ = herring less than or equal to 82 mm standard length

1+ = herring between 83 mm and 138 mm standard length
2+ and older = herring greater than or equal to 139 mm standard length

Age-0+ herring occurred in 39 of the 60 sets (65.0 % occurrence; Table 3). Table 4 shows the average length and weight for age-0+ herring, and the total herring catch weight at each set location. The mean length and weight of all sampled age-0+ herring (n=1907) was 58 mm and 2.49 g respectively.

Age-1+ herring occurred in 48 of the 60 sets (80.0% occurrence; Table 3). Table 4 shows the average length and weight for age-1+ herring, and the total herring catch weight at each set location. The mean length and weight of all sampled age-1+ herring (n=2634) was 107 mm and 16.26 g respectively.

Age-2+ herring occurred in 24 of the 60 sets (40.0 % occurrence; Table 3). Table 4 shows the average length and weight for age-2+ herring, and the total herring catch weight at each set location. The mean length and weight of all sampled age-2+ herring (n=128) was 153 mm and 50.25 g respectively.

The relationship between length and weight for all sampled herring was determined by fitting a logistic function to the length-weight data (Figure 8). Kwakshua, Thompson Bay and Kitasu Bay sets resulted in the least amount of herring caught in relation to total catch. Meyers Pass, Hunter Channel, Spiller Channel and Powell Anchorage sets resulted in the highest amount of herring caught (Table 2 and 4).

**Plankton**

There were 29 categories of organisms identified in 26 plankton samples (Tables 5 and 6). An average of 14.4476 $m^3$ of water was filtered per plankton tow. Copepods occurred in all samples along with *Acartia longimeres* and larval euphausiids. *Acartia longimeres*, larvaceans (*Oikopleura sp.* and *Fritillaria sp.*), crab zoea, larval euphausiids, and *Pseudocalanus sp.* occurred in >95 % of samples (Table 7). *Acartia longimeres* and *Pseudocalanus sp.* made up >55 % of all zooplankton biomass captured.

**CTD**

Two CTD casts were performed at each location before plankton sampling. The CTD provided a range of data for temperature ($^{o}$C), salinity (ppt), dissolved oxygen (%) and depth (m) (Figure 9). This is only the second year that CTD casts have been made; therefore, we have limited data for making broad observations relative to offshore ocean conditions in our sampling areas.

## CONCLUSION

Sixty stations were sampled resulting in 14 different fish species being recorded from the purse seine sets. A total of 4669 herring were measured and weighed creating a distinct bimodal histogram representing two juvenile herring age groups. Twenty-six plankton tows were performed with all plankton samples being processed. This resulted in *Acartia longimeres*, larval euphausiids and *Pseudocalanus sp.* occurring in all samples and *Acartia longimeres* and *Pseudocalanus sp.* showing up in the largest biomass.

## ACKNOWLEDGMENTS

This study was funded by Fisheries and Oceans Canada (DFO) along with vessel support and laboratory facilities. The research vessel was skippered by Don Houston. Don provides many years of valuable experience as a herring fisherman and knowledge of the Central Coast. All plankton samples were processed by Carol Cooper of Zotec Services. Thanks to Kristen Daniel for producing location maps.

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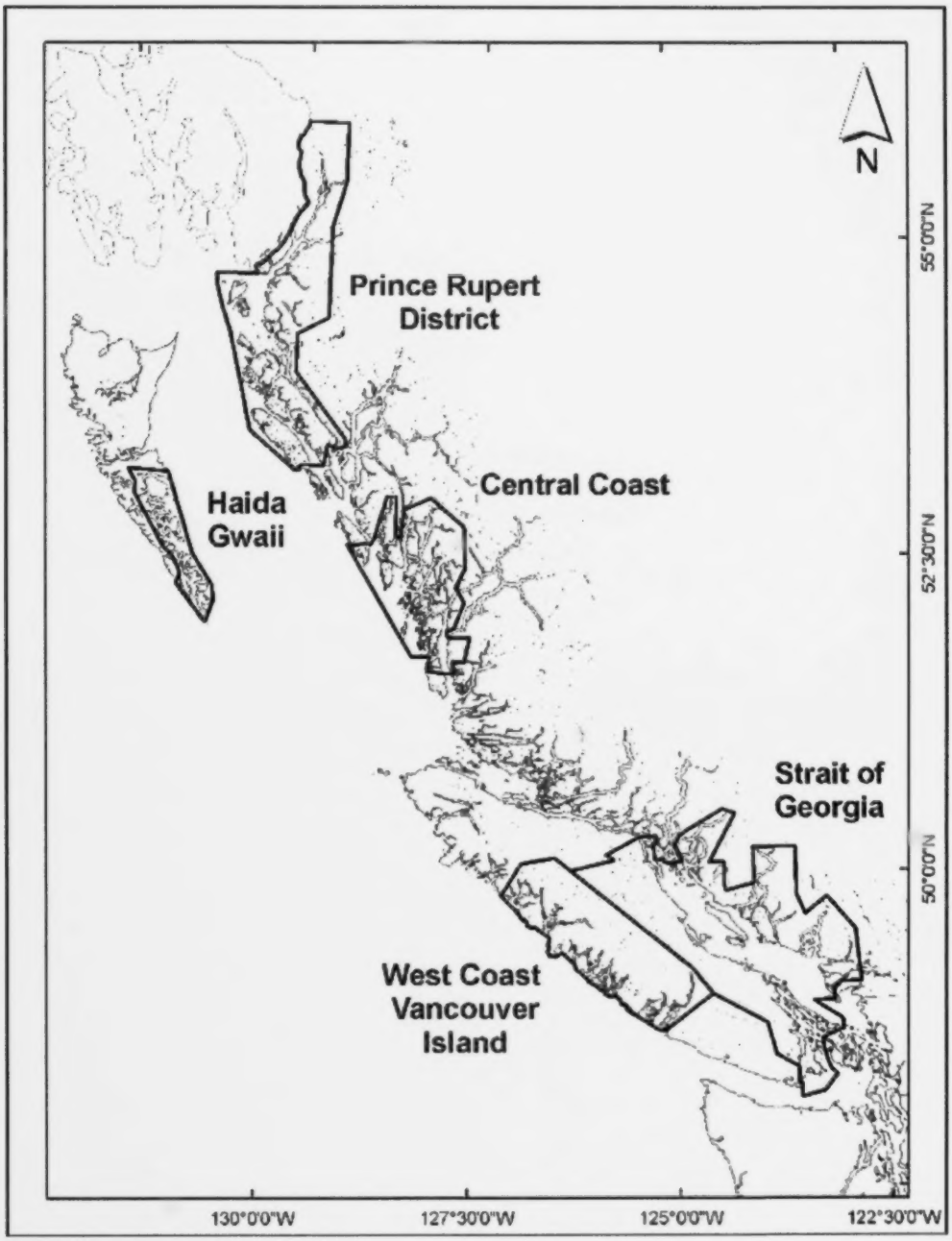



Figure 1. The five major British Columbia herring stock assessment areas.

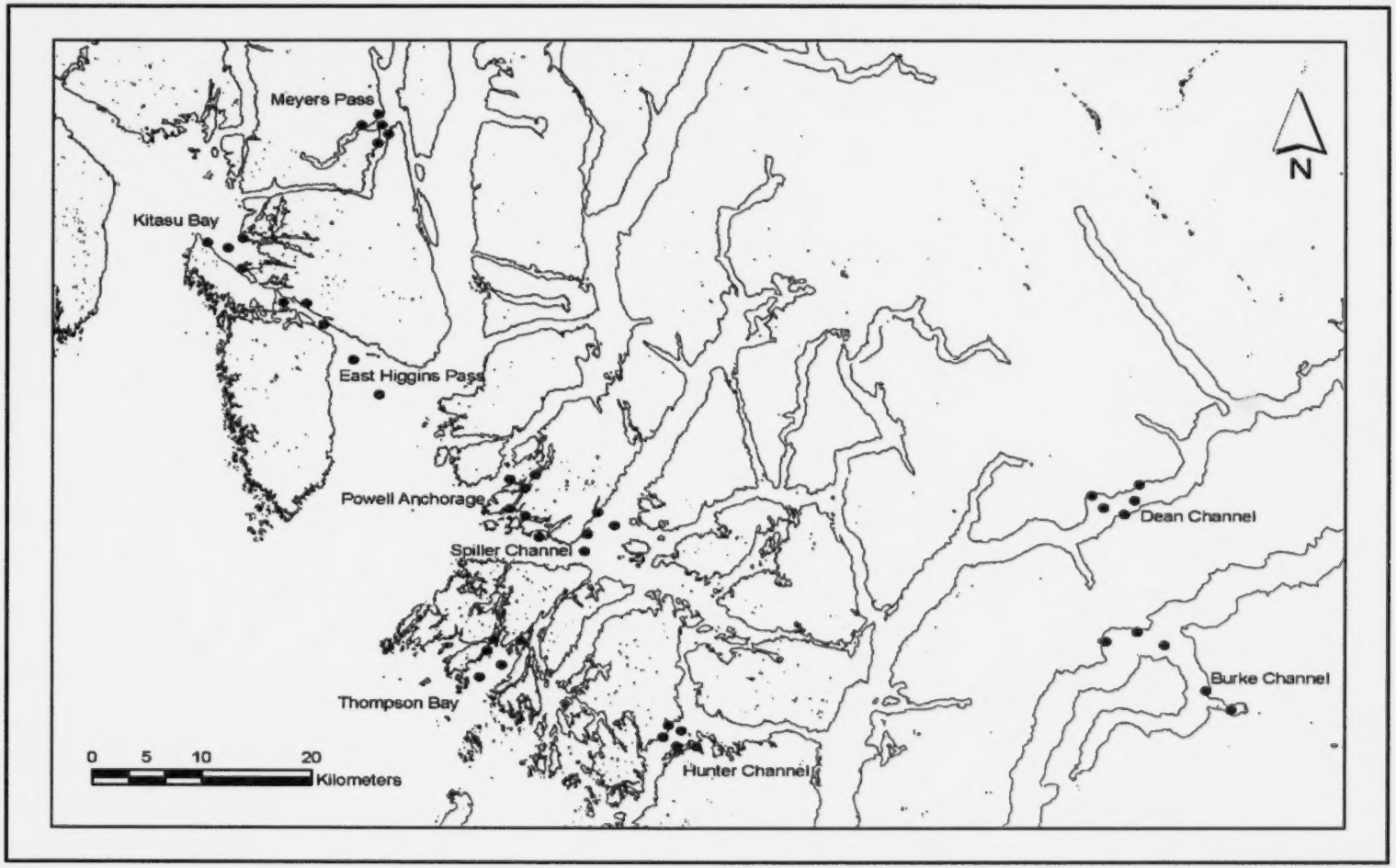



Figure 2. Upper Central Coast purse seine set locations for the 2009 juvenile herring survey.

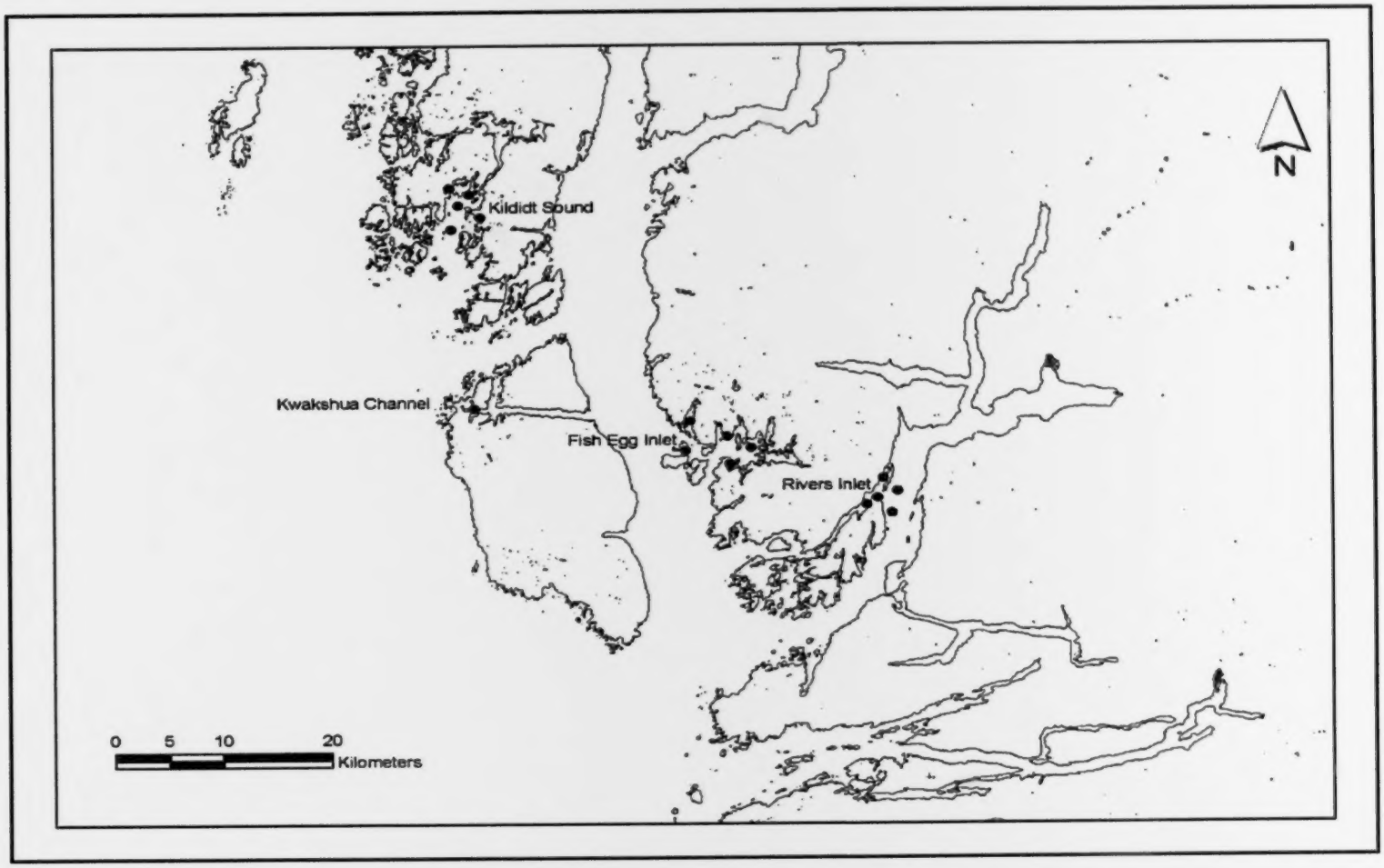



Figure 3. Lower Central Coast purse seine set locations for the 2009 juvenile herring survey.

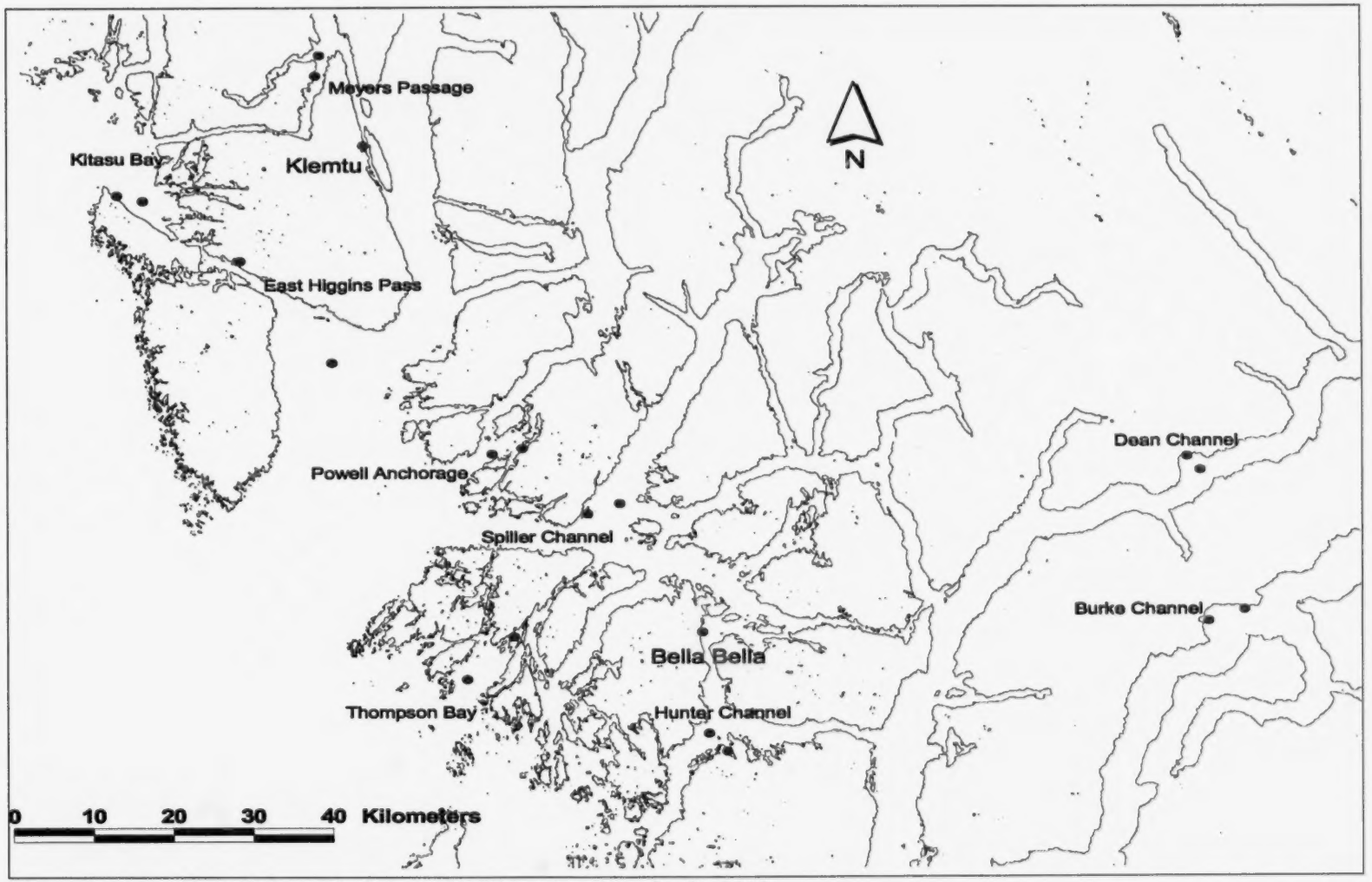



Figure 4. Upper Central Coast plankton and CTD set locations for the 2009 survey.

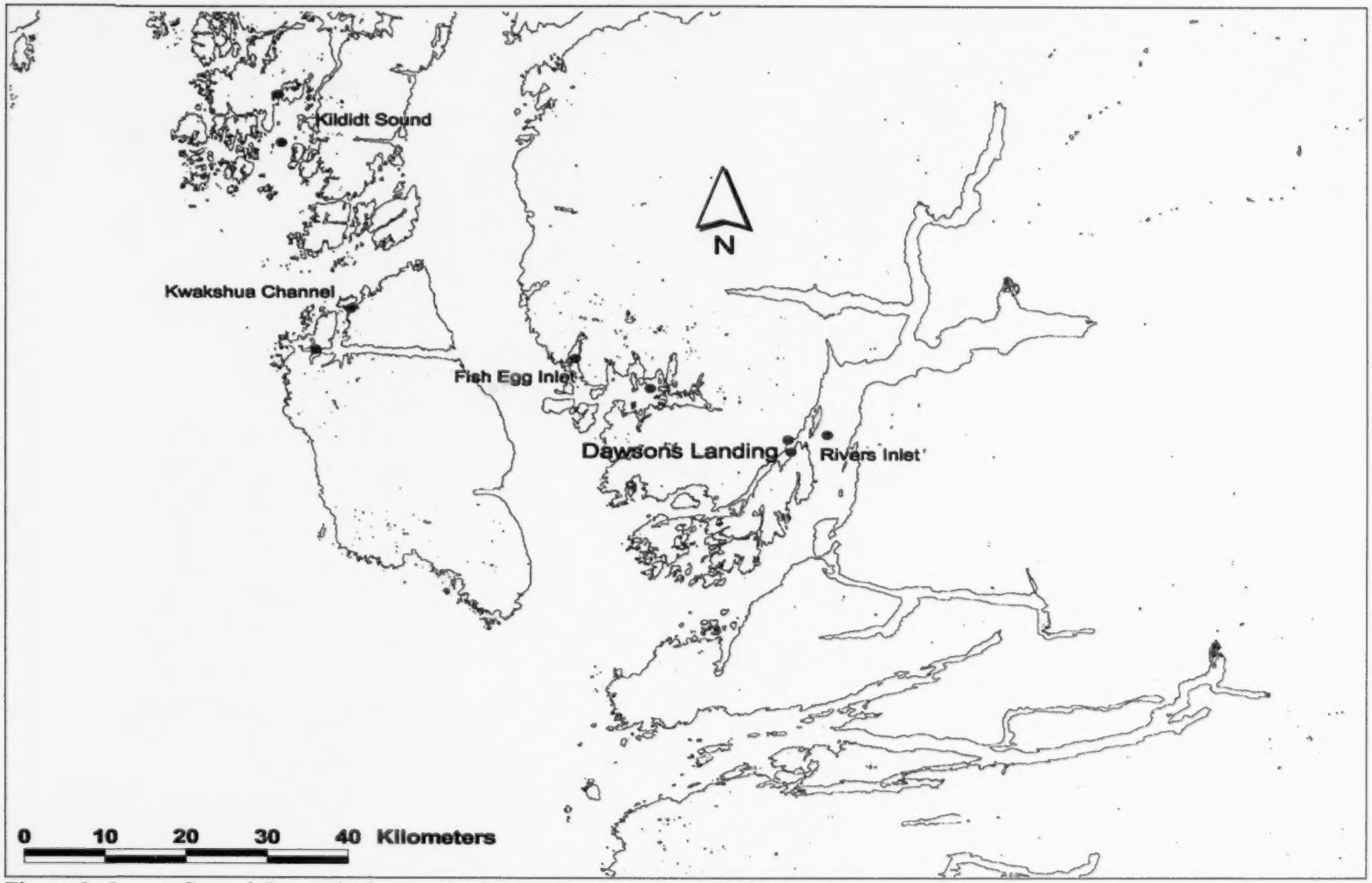



Figure 5. Lower Central Coast plankton and CTD set locations for the 2009 survey.

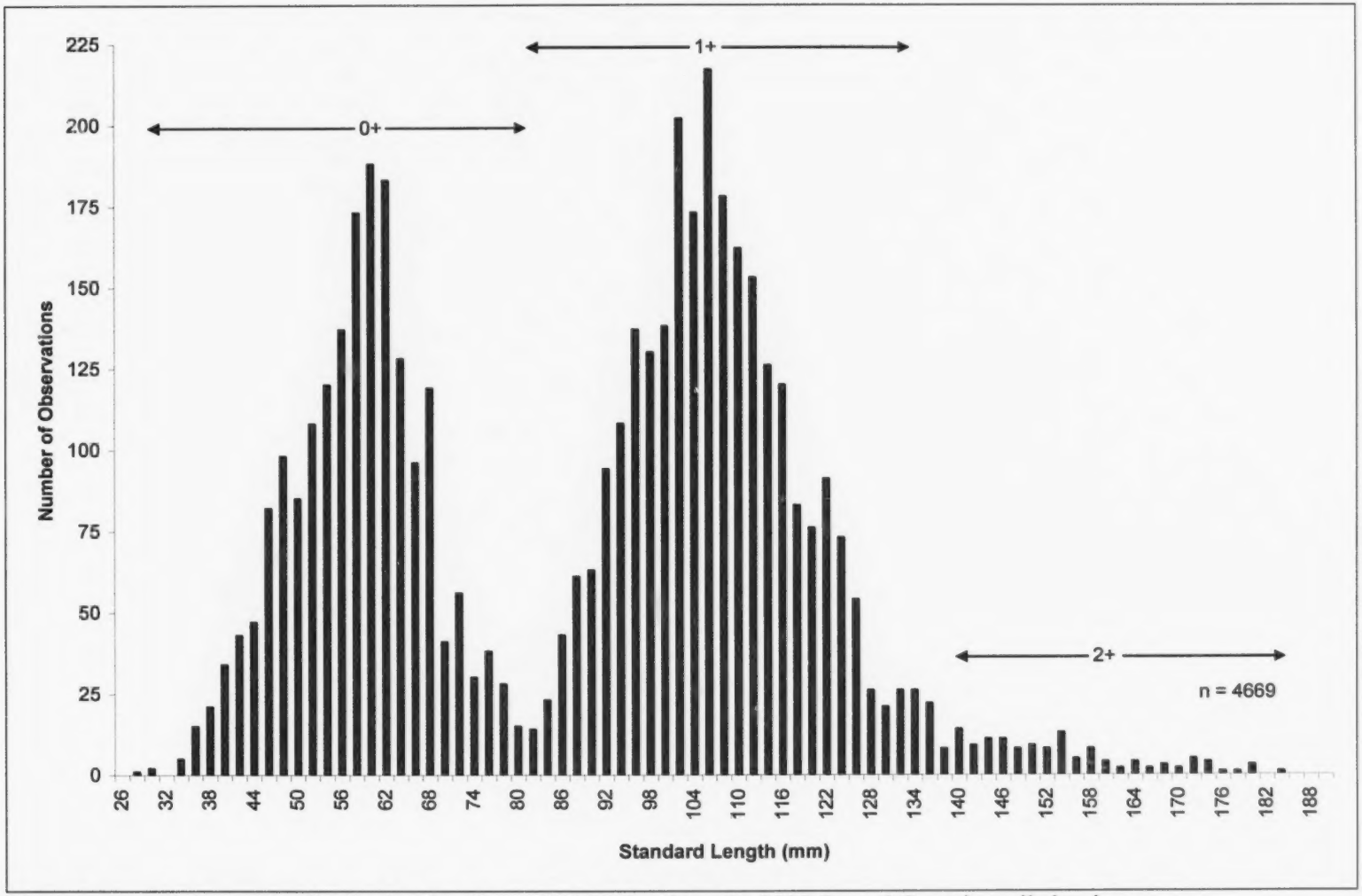
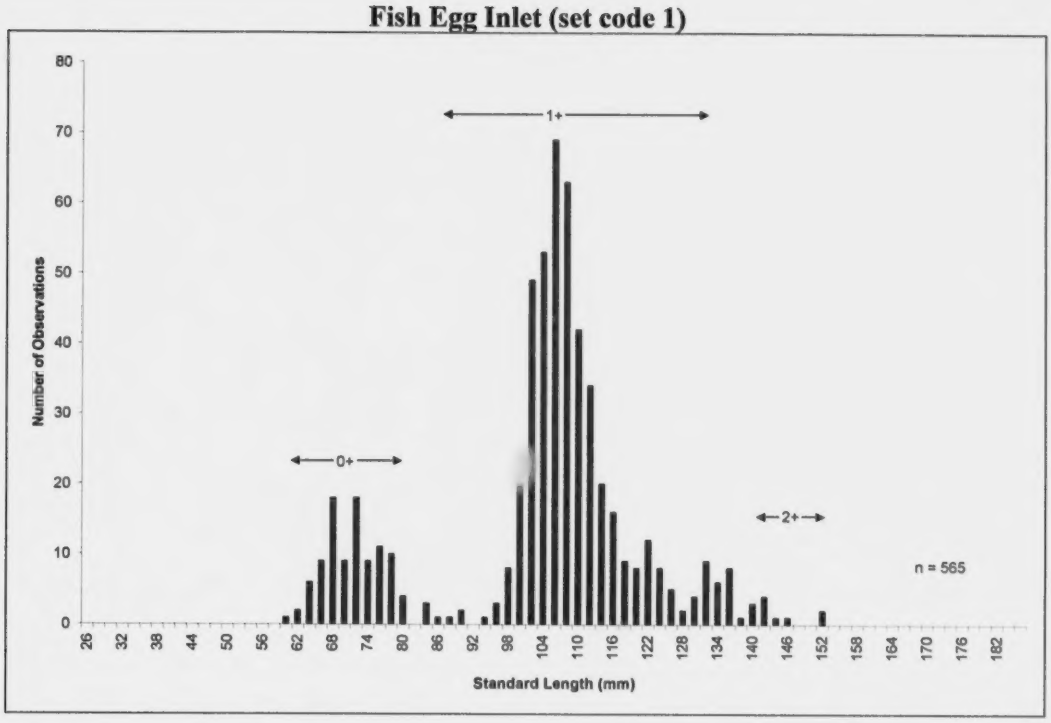



Figure 6. Length-frequency distribution for all sampled herring from the 2009 Central Coast juvenile herring survey.



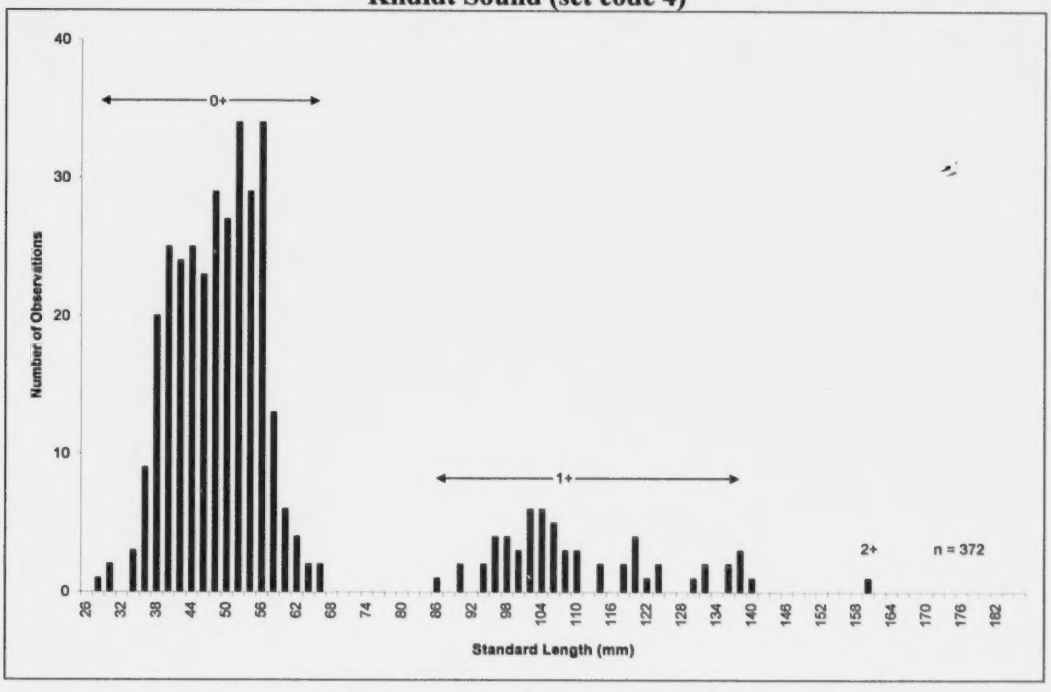
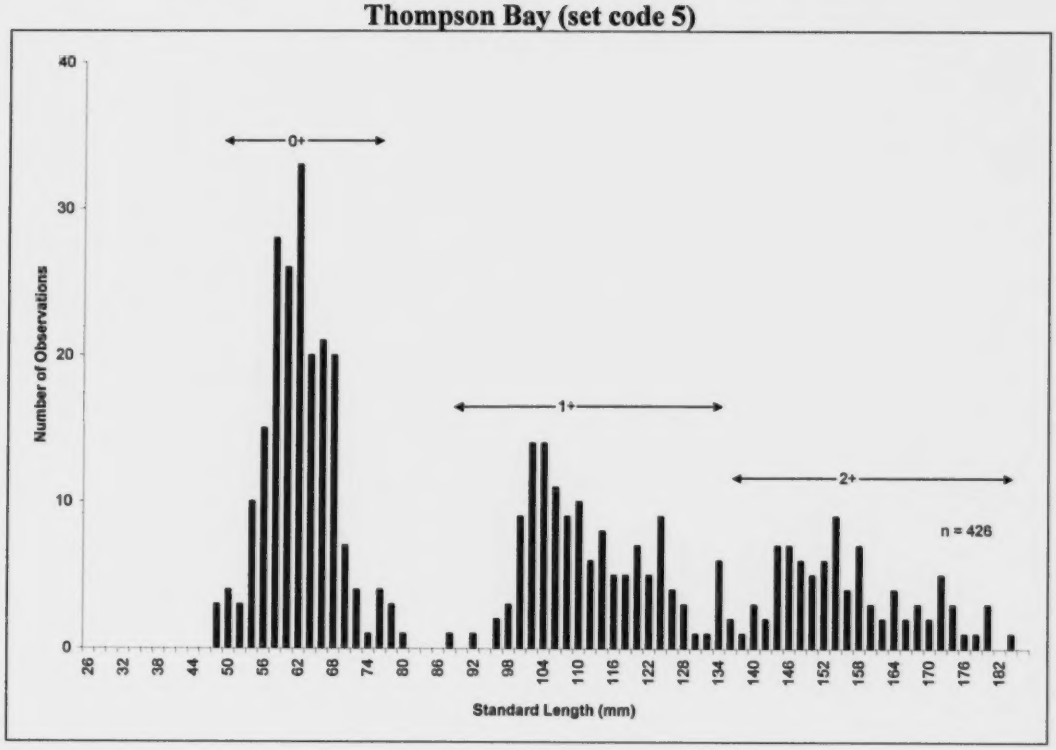




Figure 7. Length-frequency histograms by location (set code) for the 2009 Central Coast juvenile herring survey.



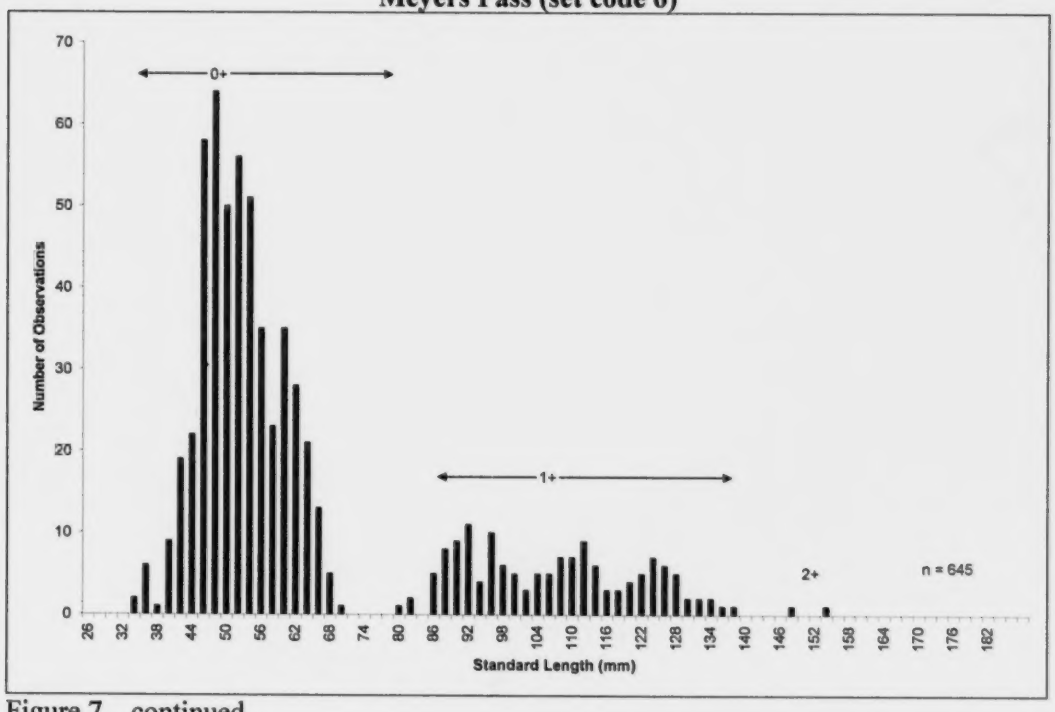
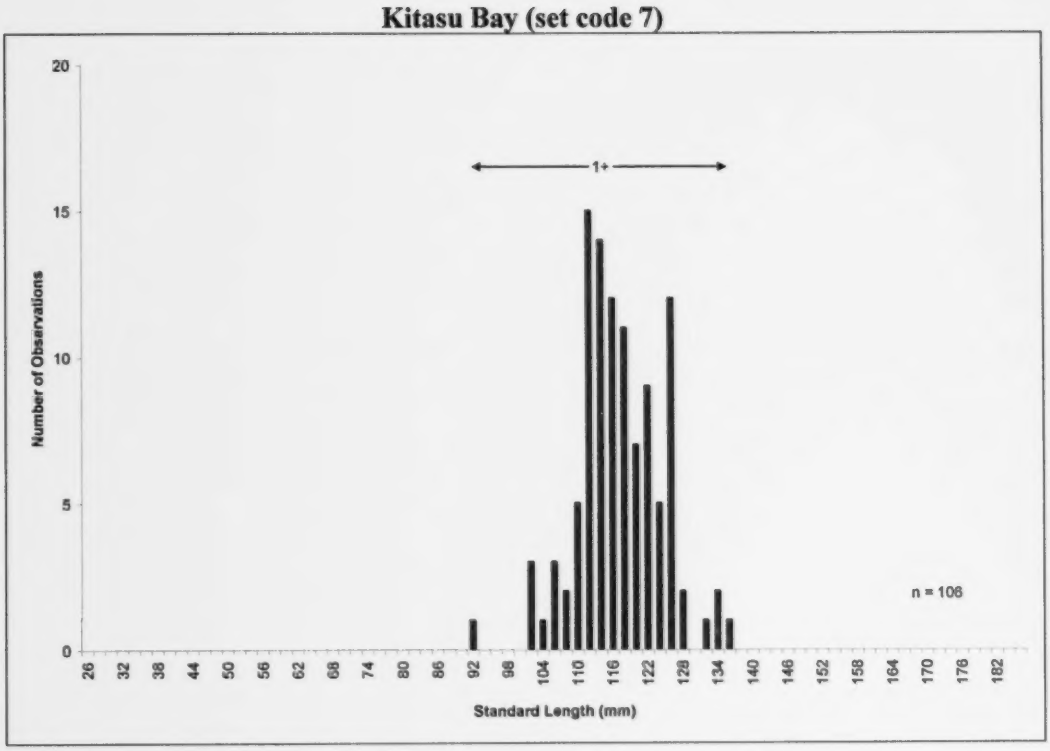




Figure 7...continued



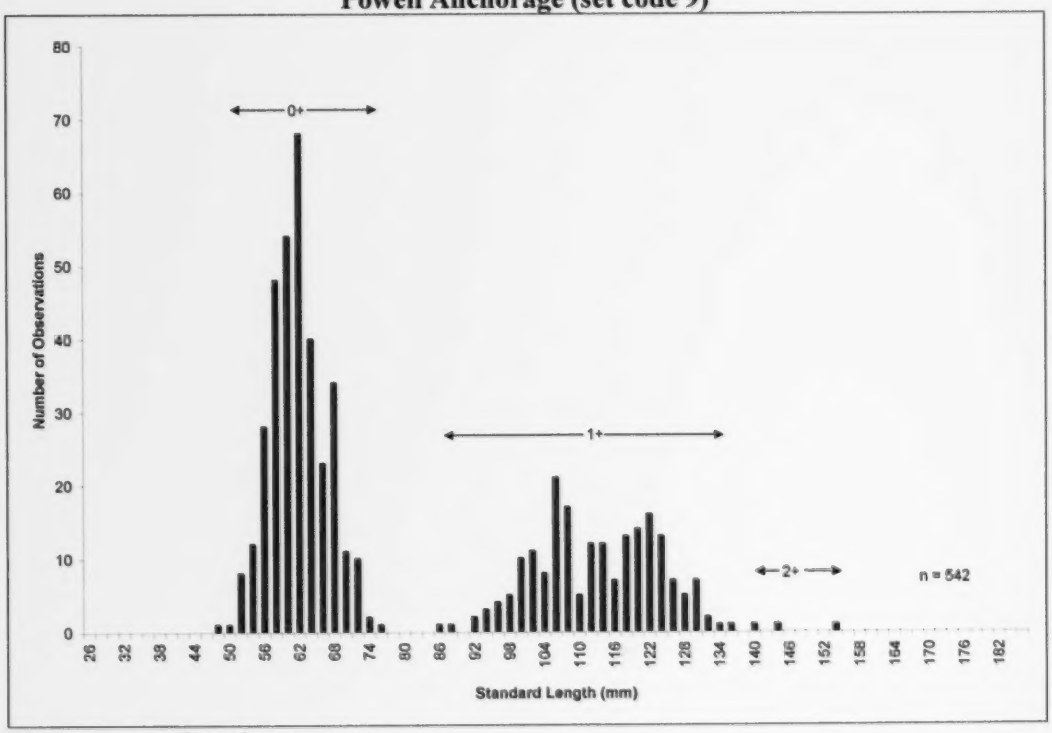
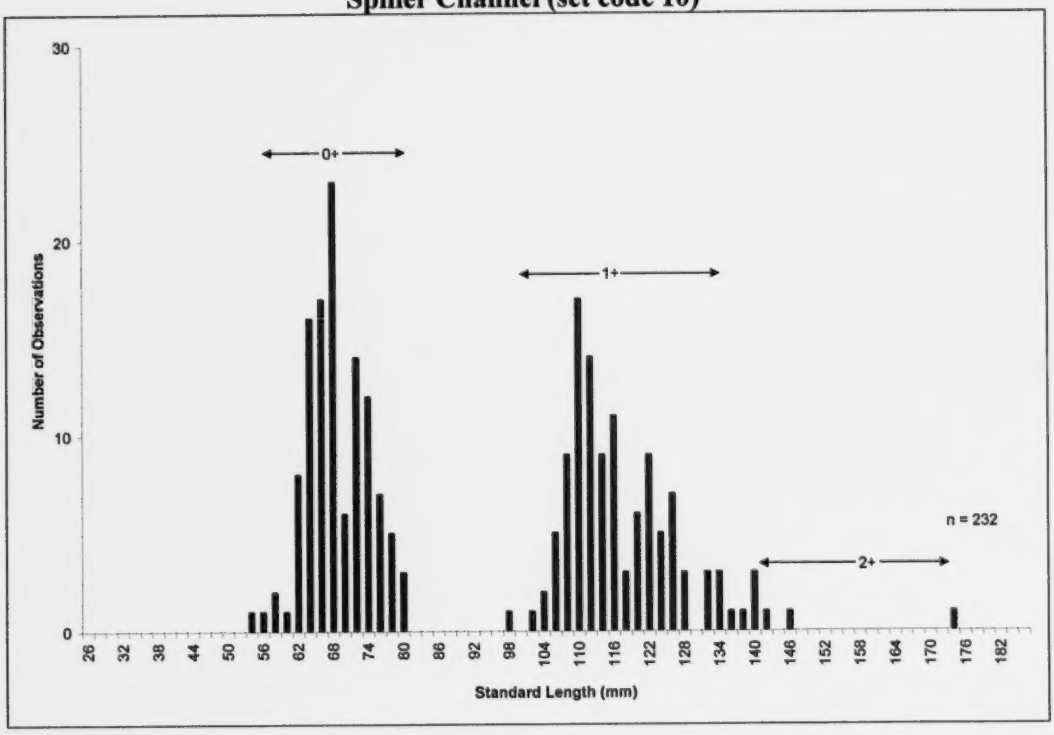




Figure 7...continued

**Spiller Channel (set code 10)**




**Hunter Channel (set code 11)**

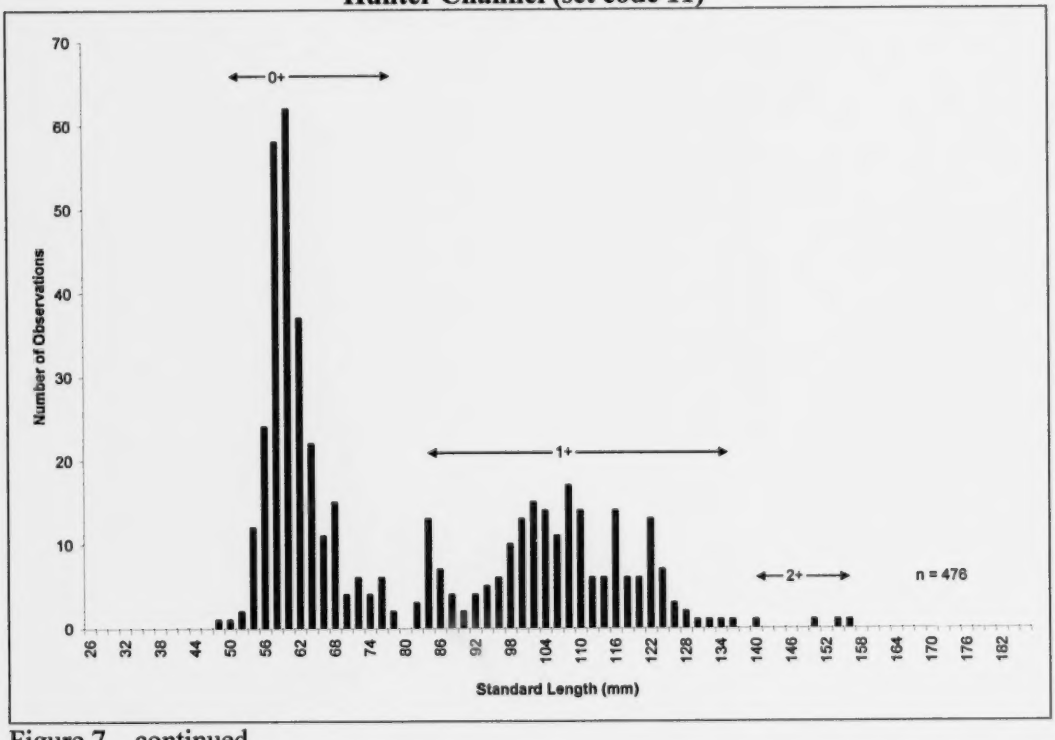
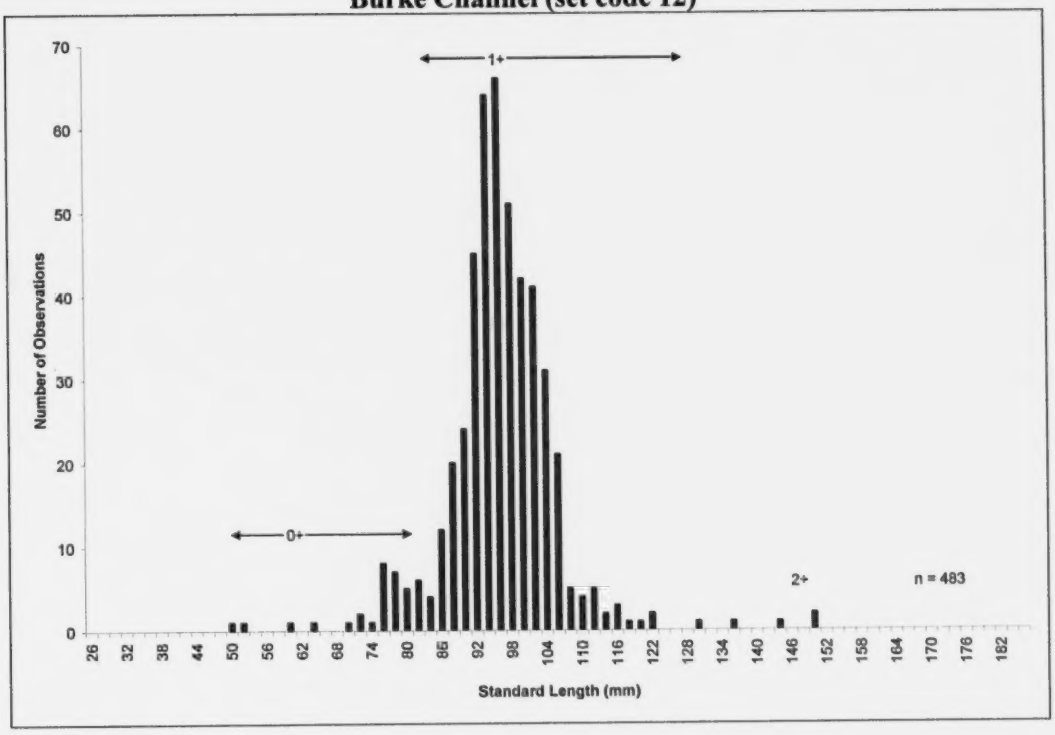



Figure 7…continued

**Burke Channel (set code 12)**




**Dean Channel (set code 13)**

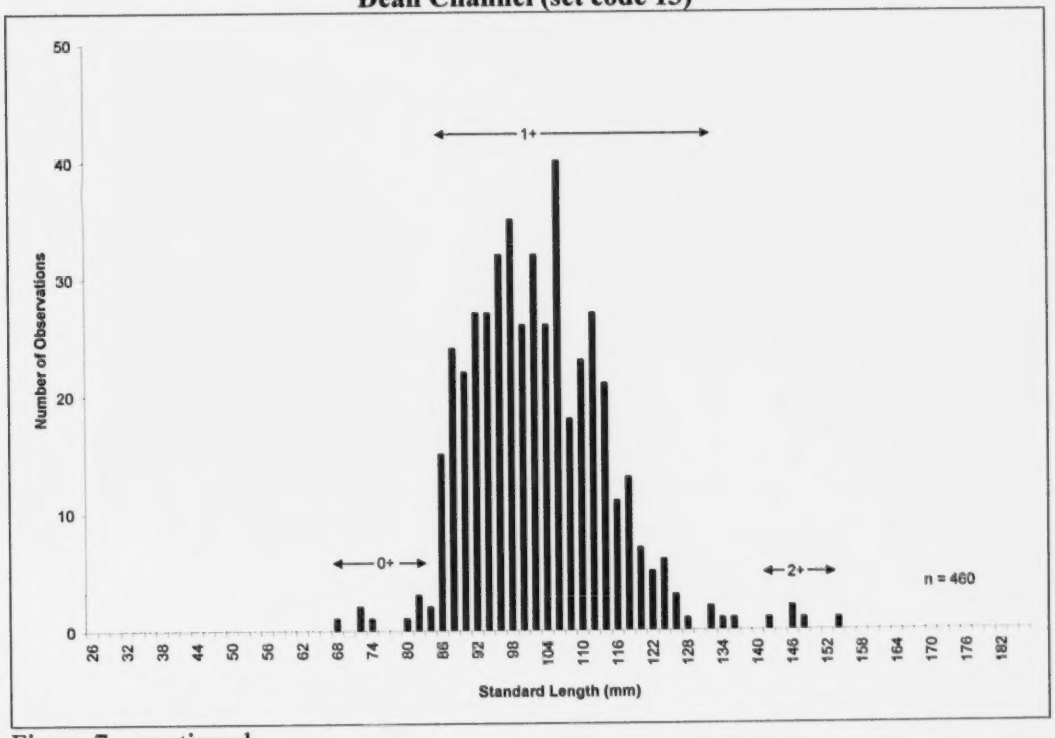



Figure 7…continued

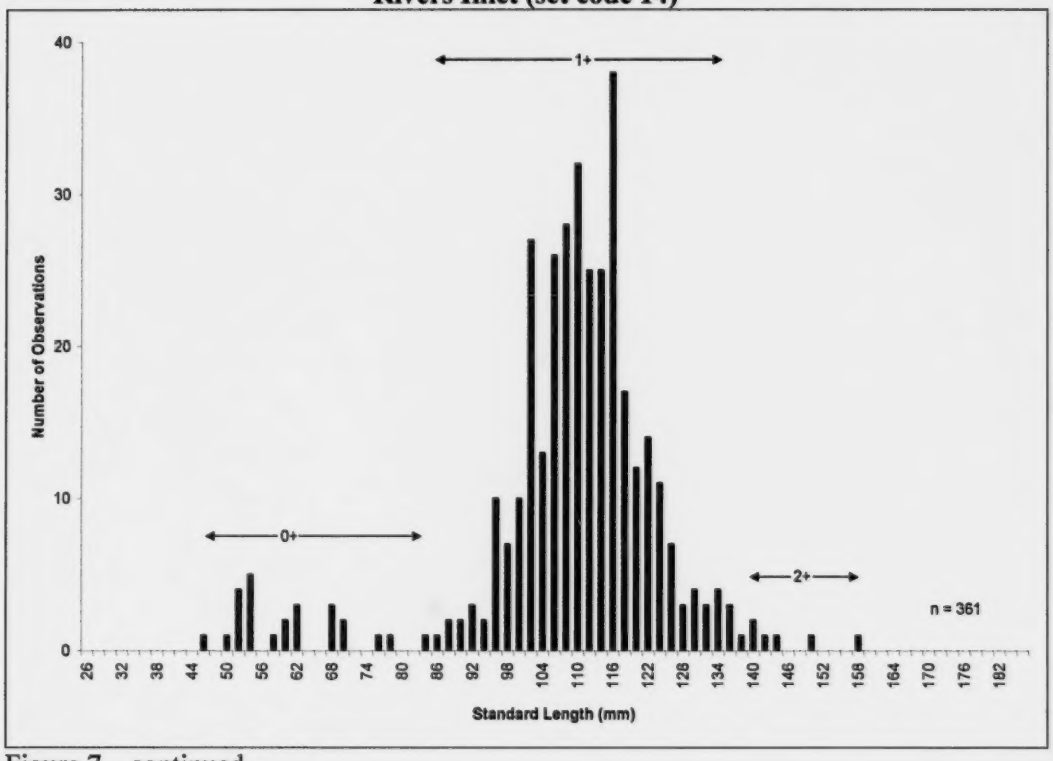


Figure 7…continued

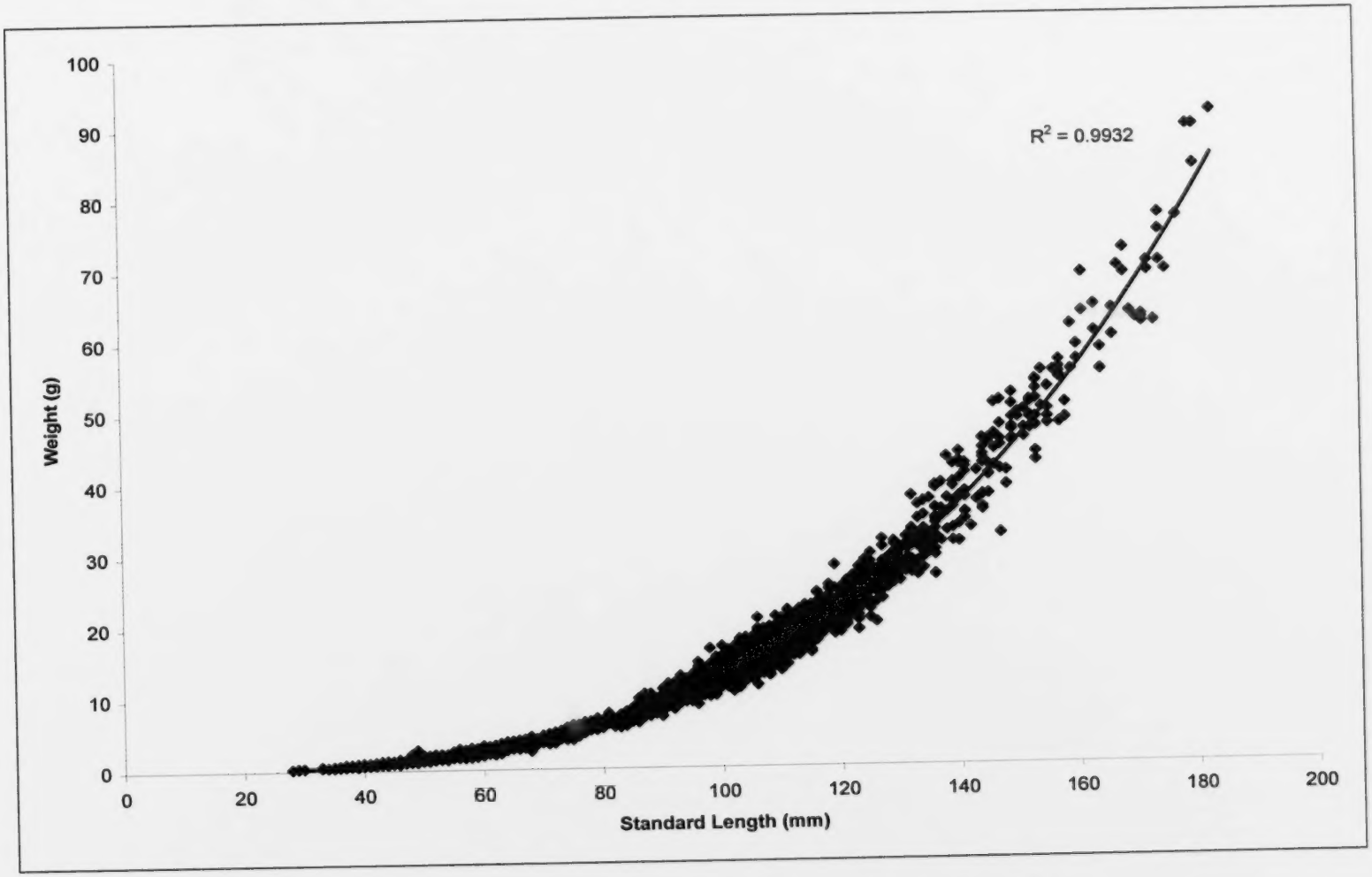



Figure 8. Length-weight relationship for all sampled herring from the 2009 Central Coast juvenile herring survey.

**Fish Egg Inlet (set code 1)**

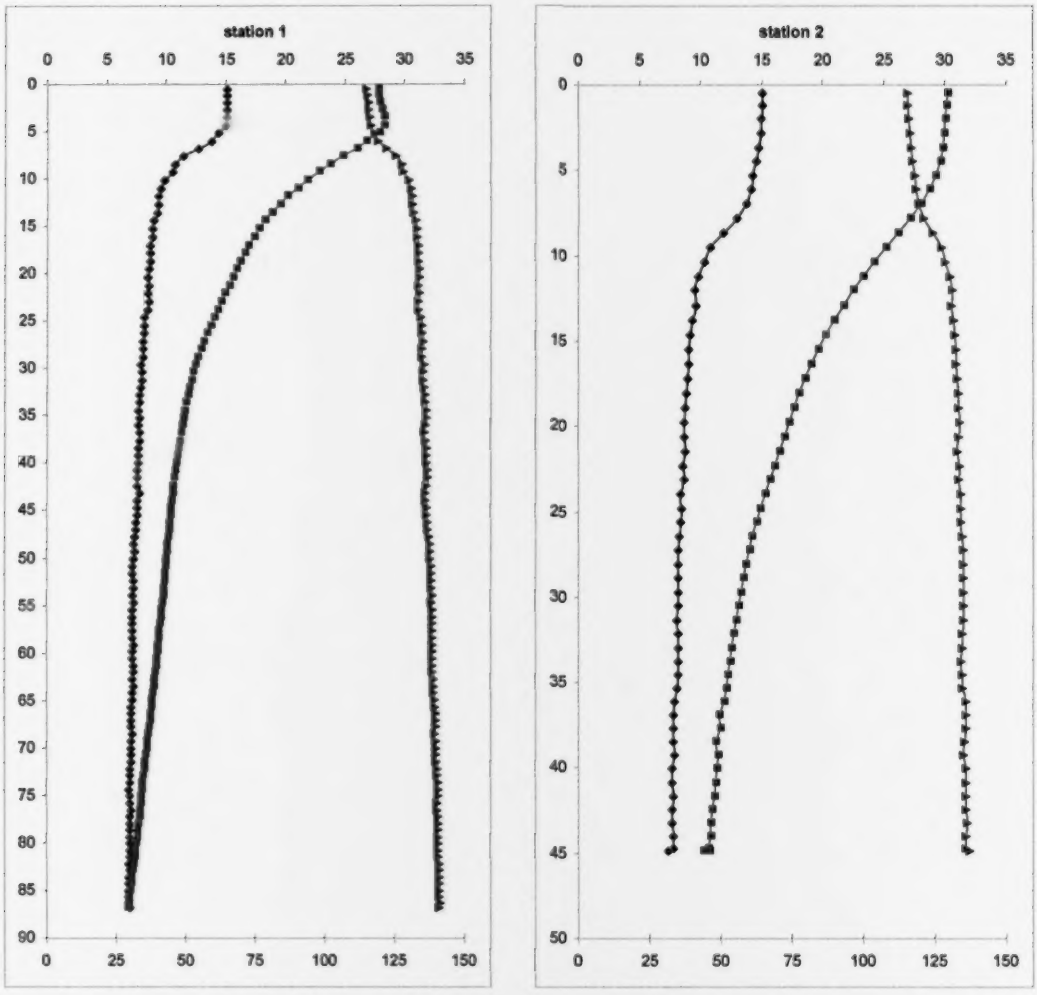



Figure 9. Temperature, salinity and dissolved oxygen profiles from CTD casts during the 2009 Central Coast juvenile herring survey.

## Kwakshua Channel (set code 2)

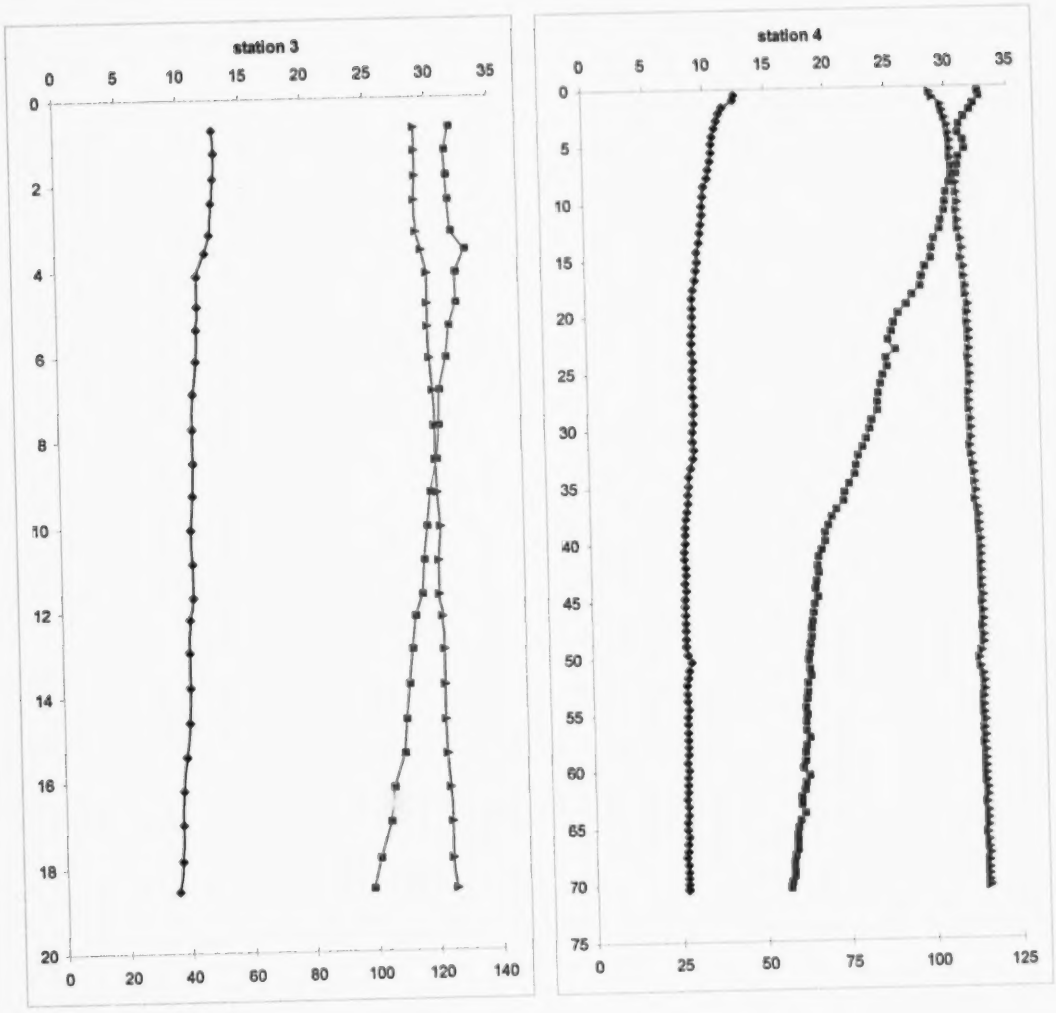



Figure 9 continued…

## Kildidt Sound (set code 4)

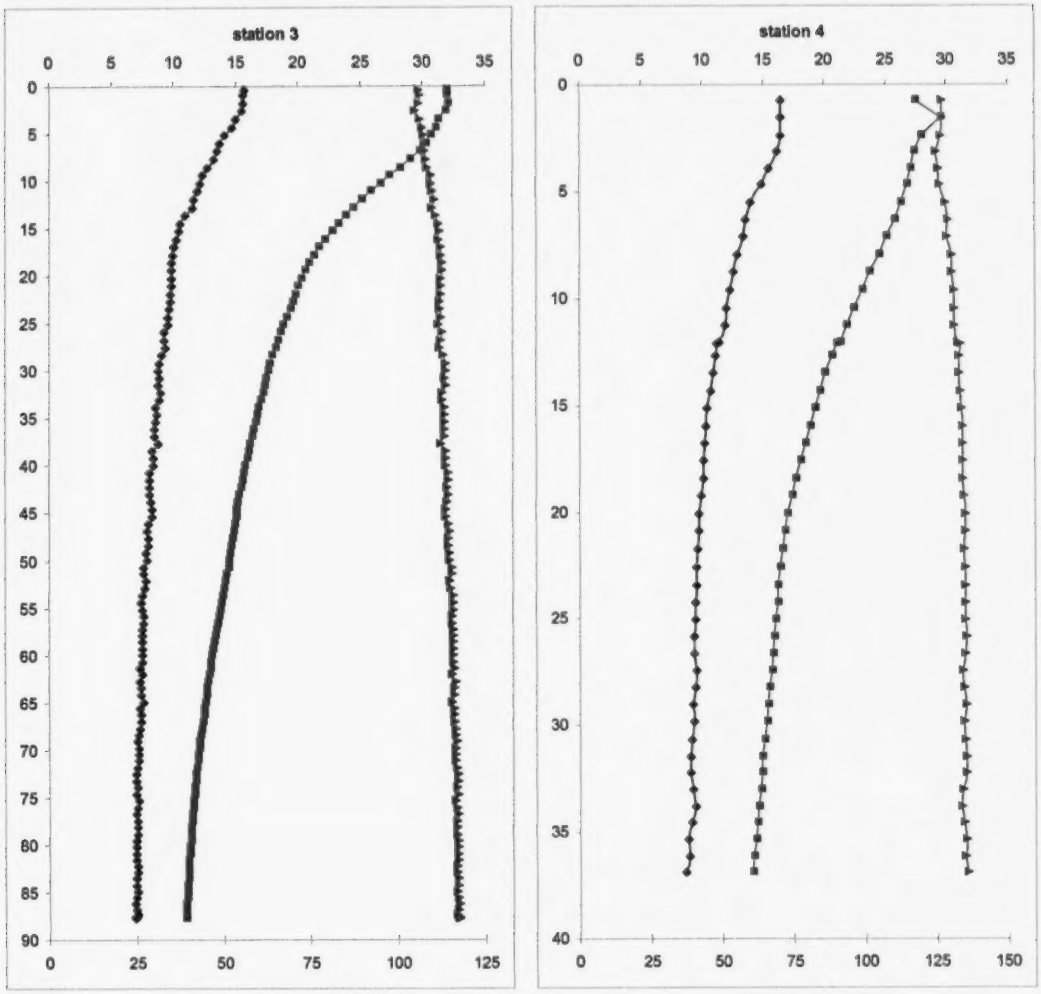



Figure 9 continued…

## Thompson Bay (set code 5)

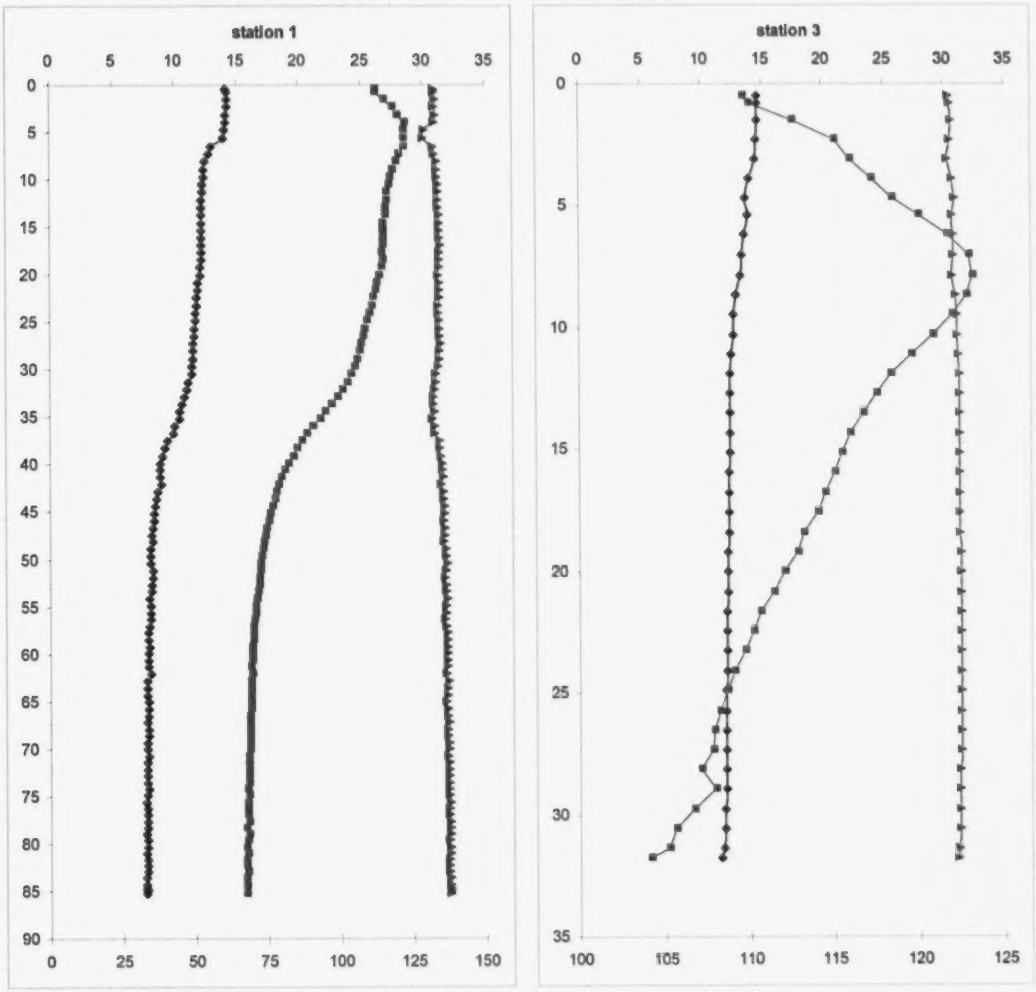



Figure 9 continued…

## Meyers Passage (set code 6)

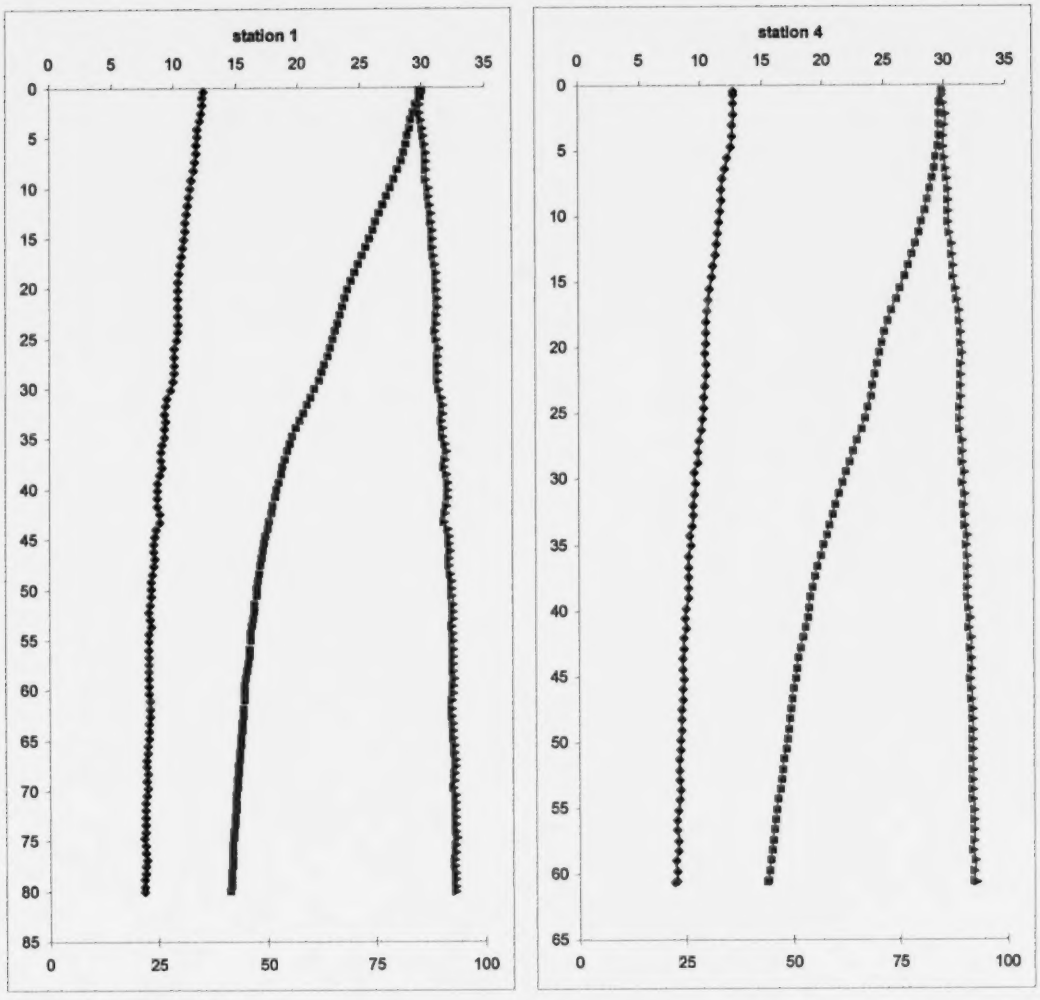



Figure 9 continued…

**Kitasu Bay (set code 7)**

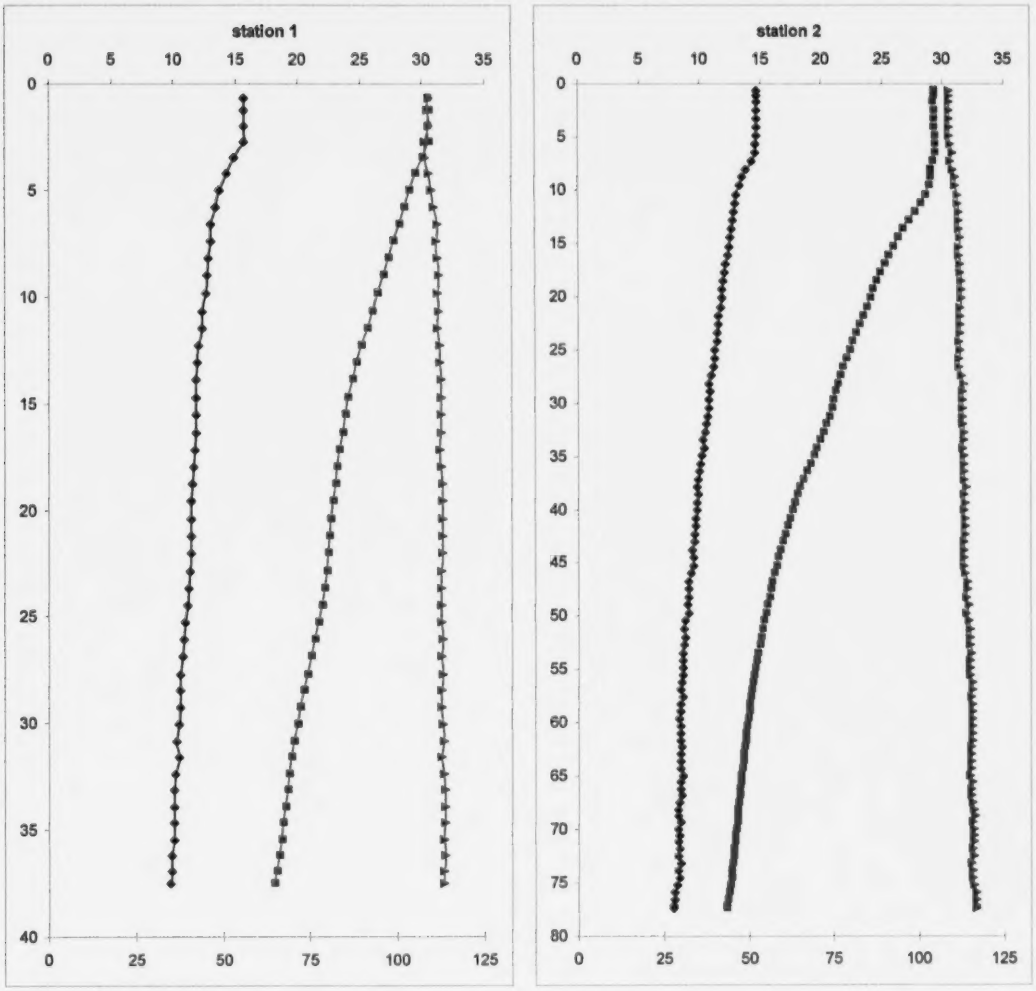



Figure 9 continued…

## East Higgins Pass (set code 8)

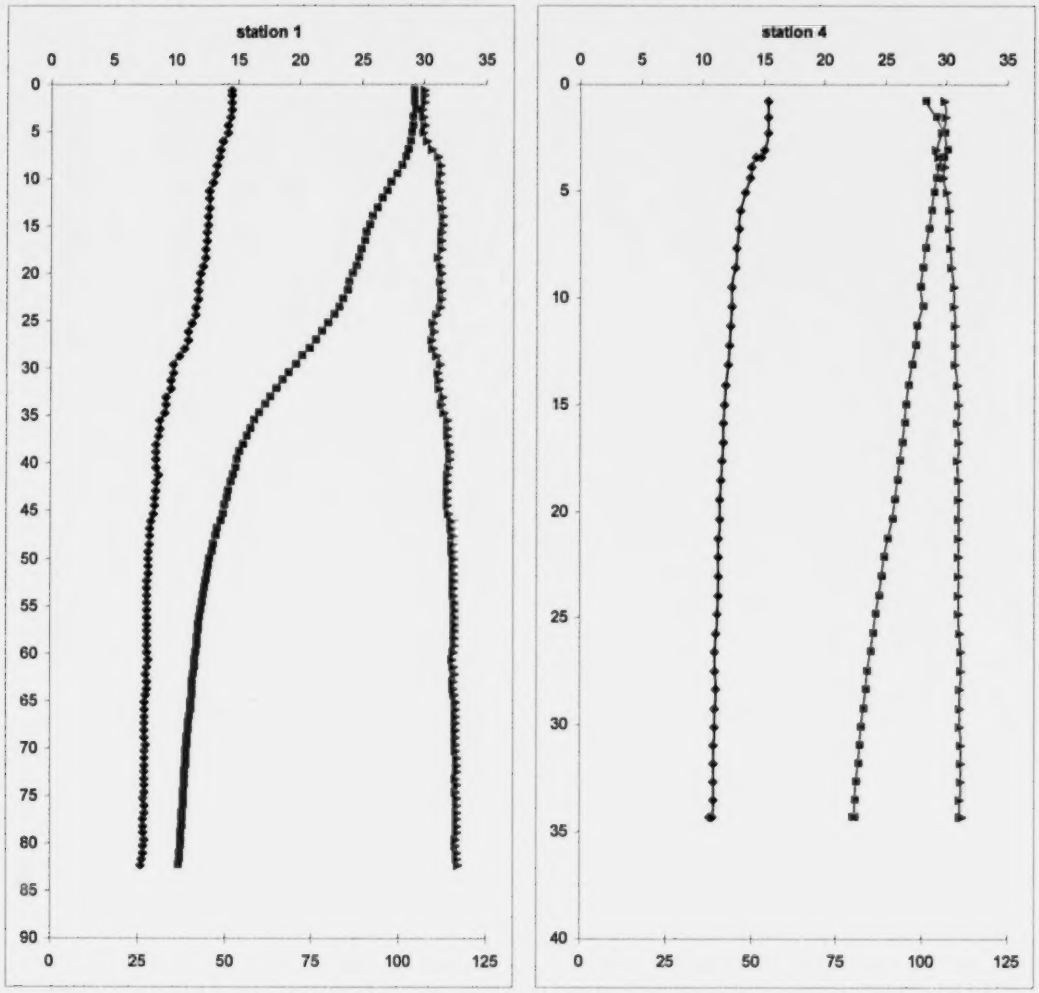



Figure 9 continued…

## Powell Anchorage (set code 9)

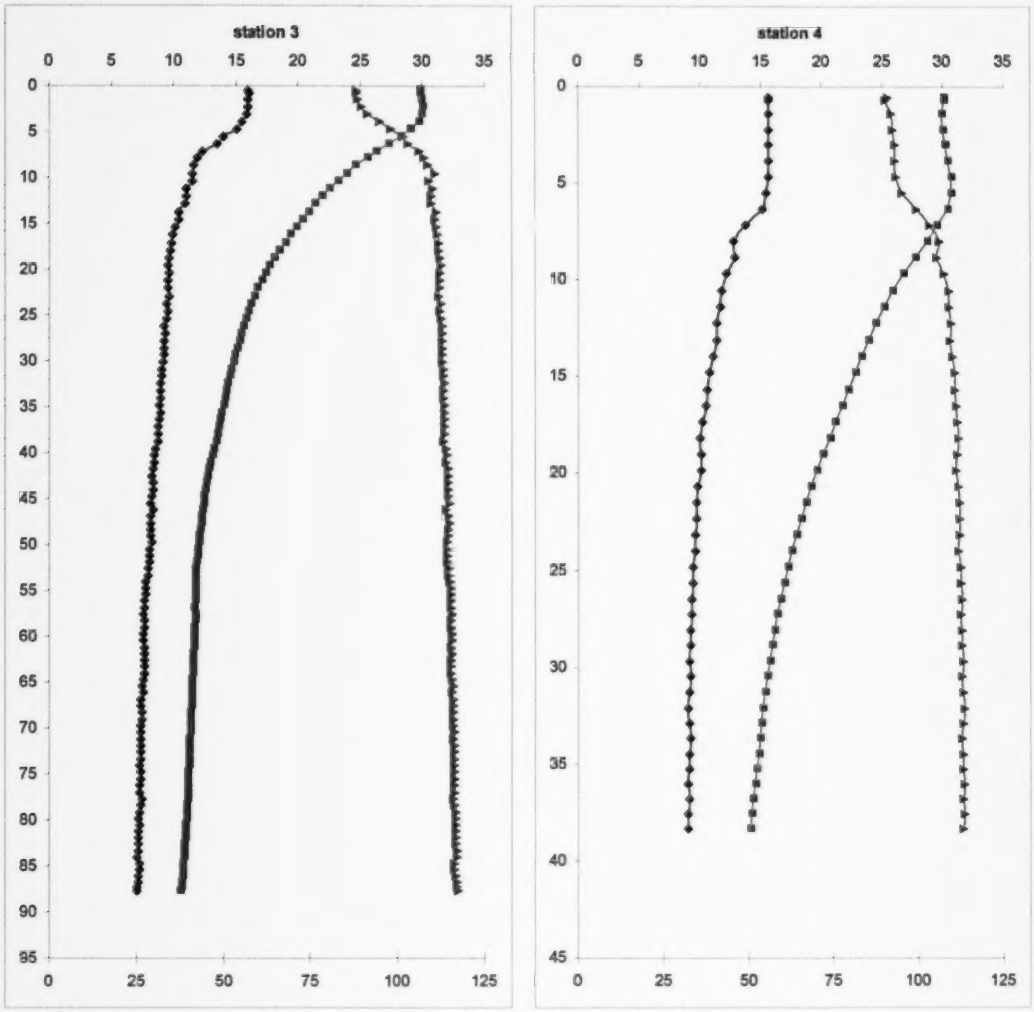



Figure 9 continued…

## Spiller Channel (set code 10)

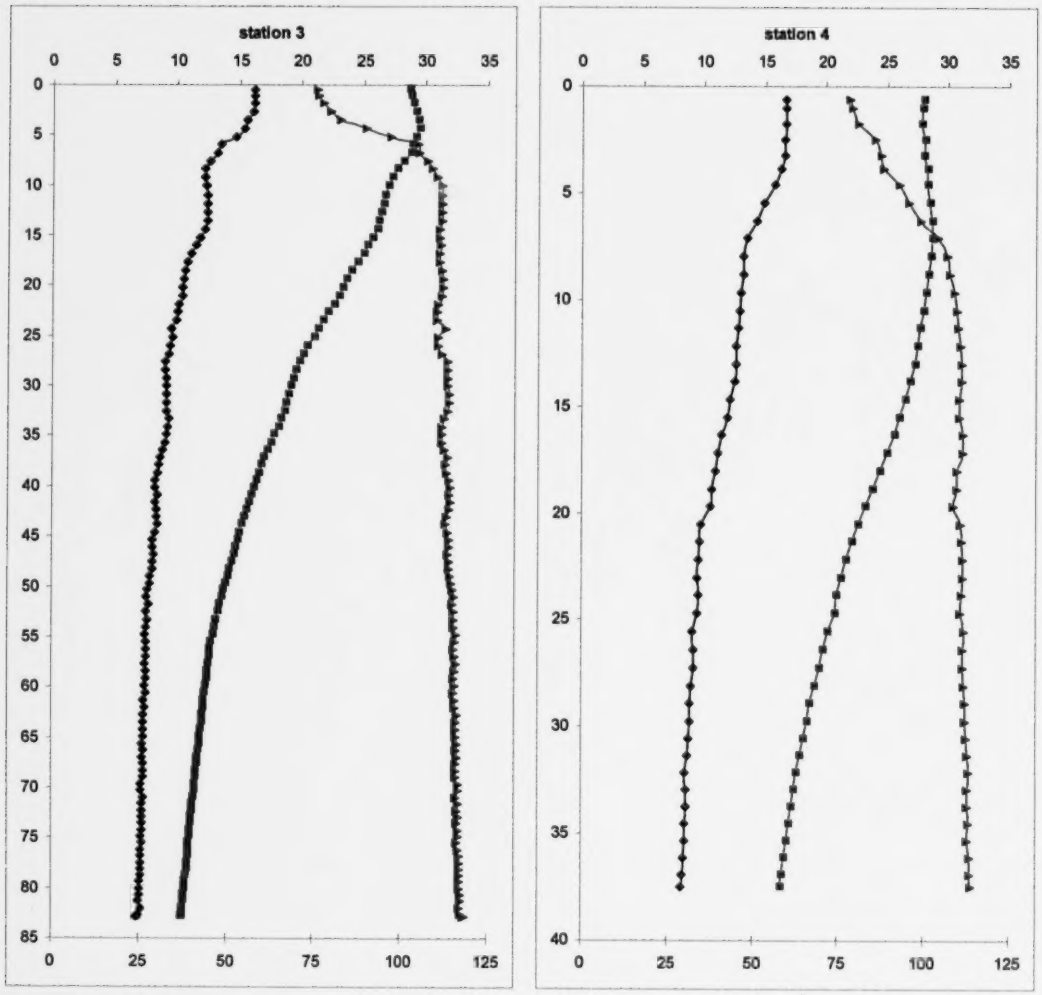



Figure 9 continued…

## Hunter Channel (set code 11)

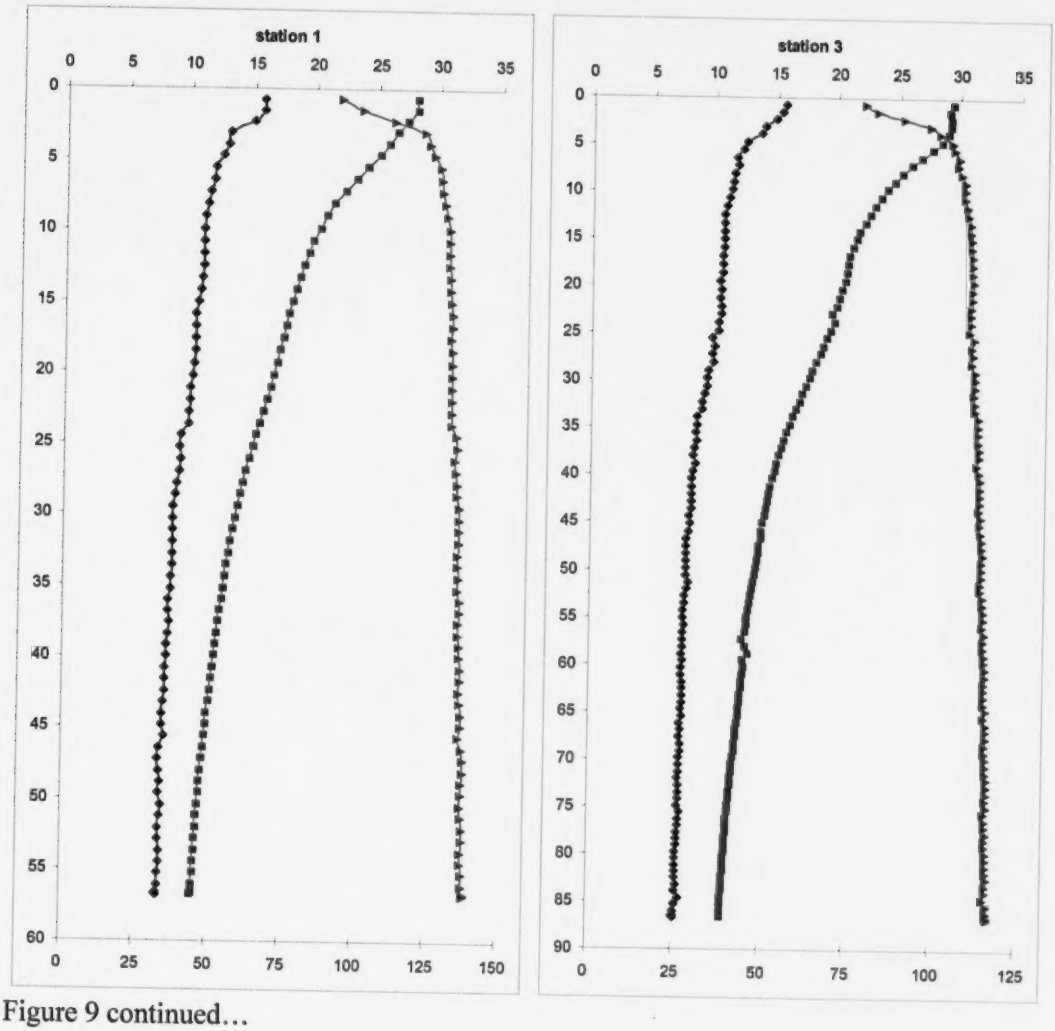



Figure 9 continued…

## Burke Channel (set code 12)

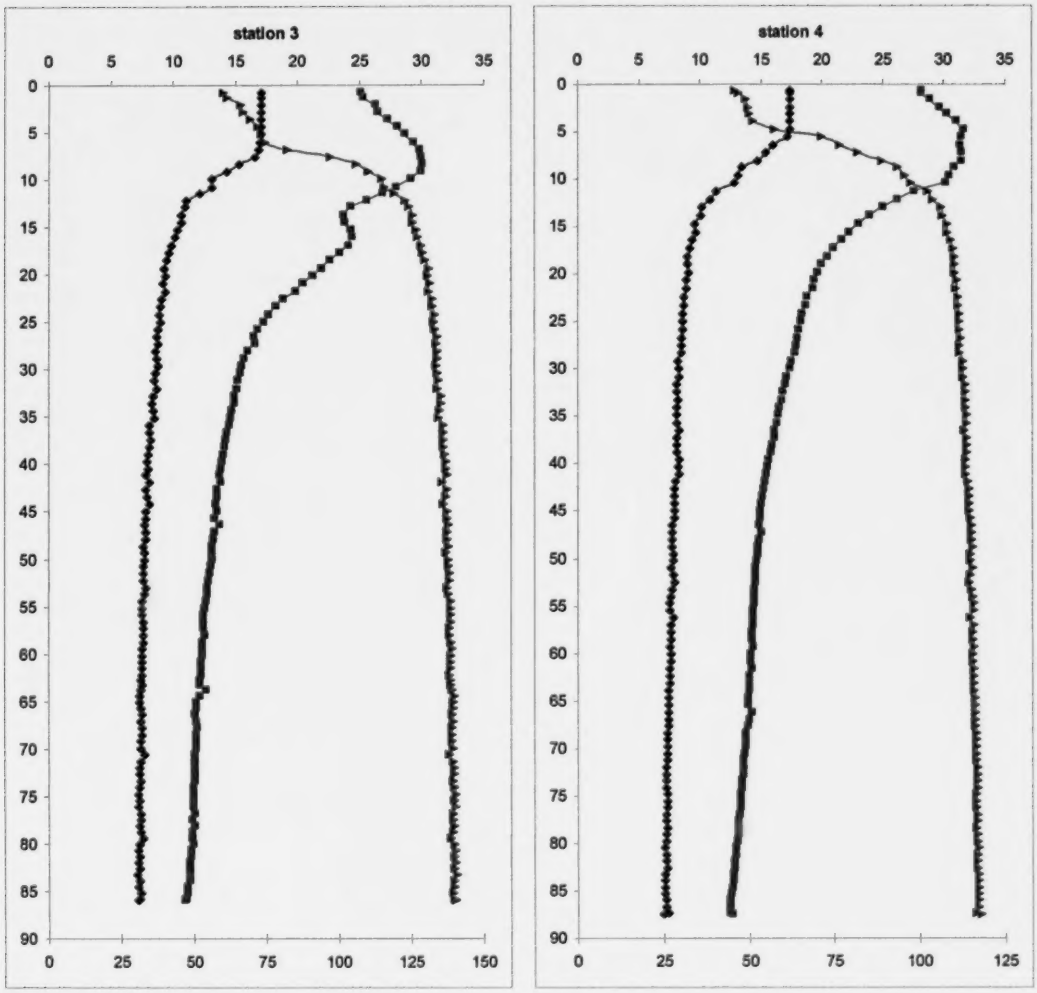



Figure 9 continued…

**Dean Channel (set code 13)**

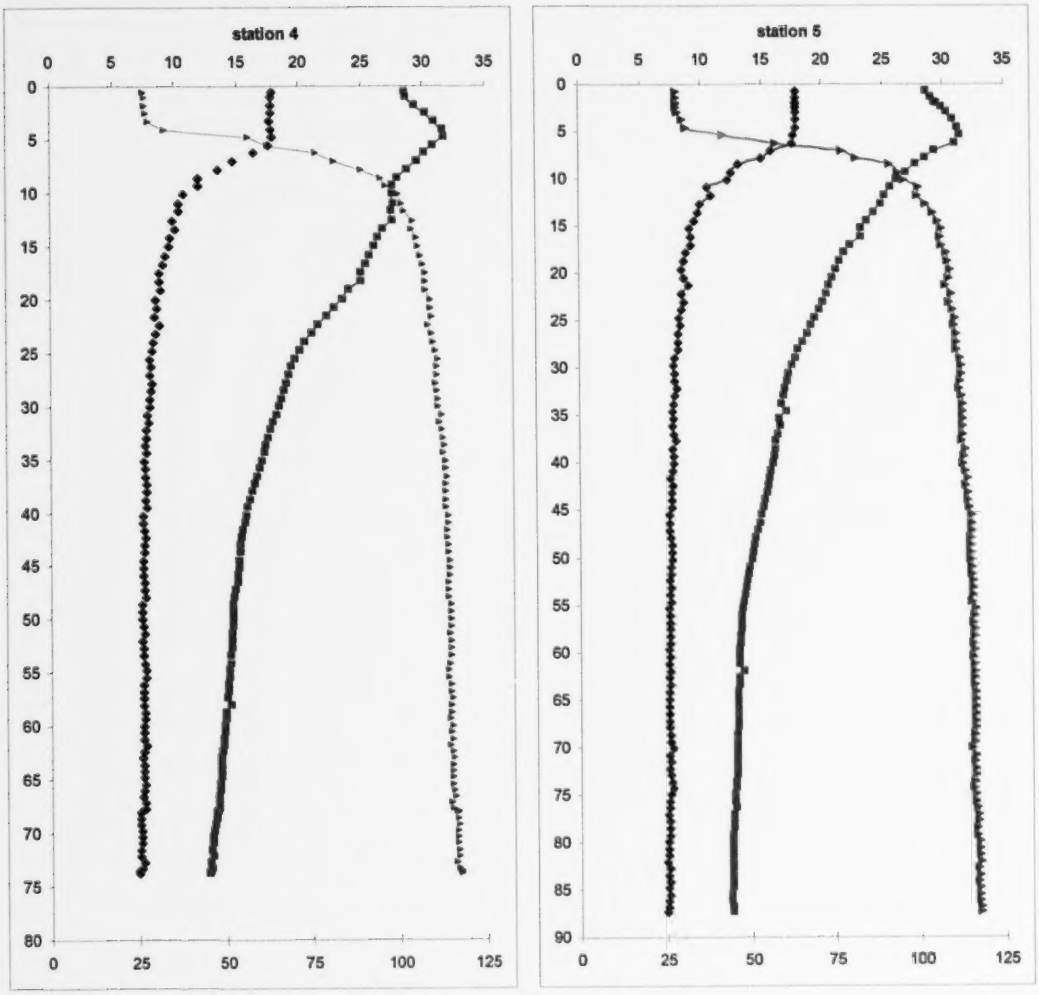



Figure 9 continued…

## Rivers Inlet (set code 14)

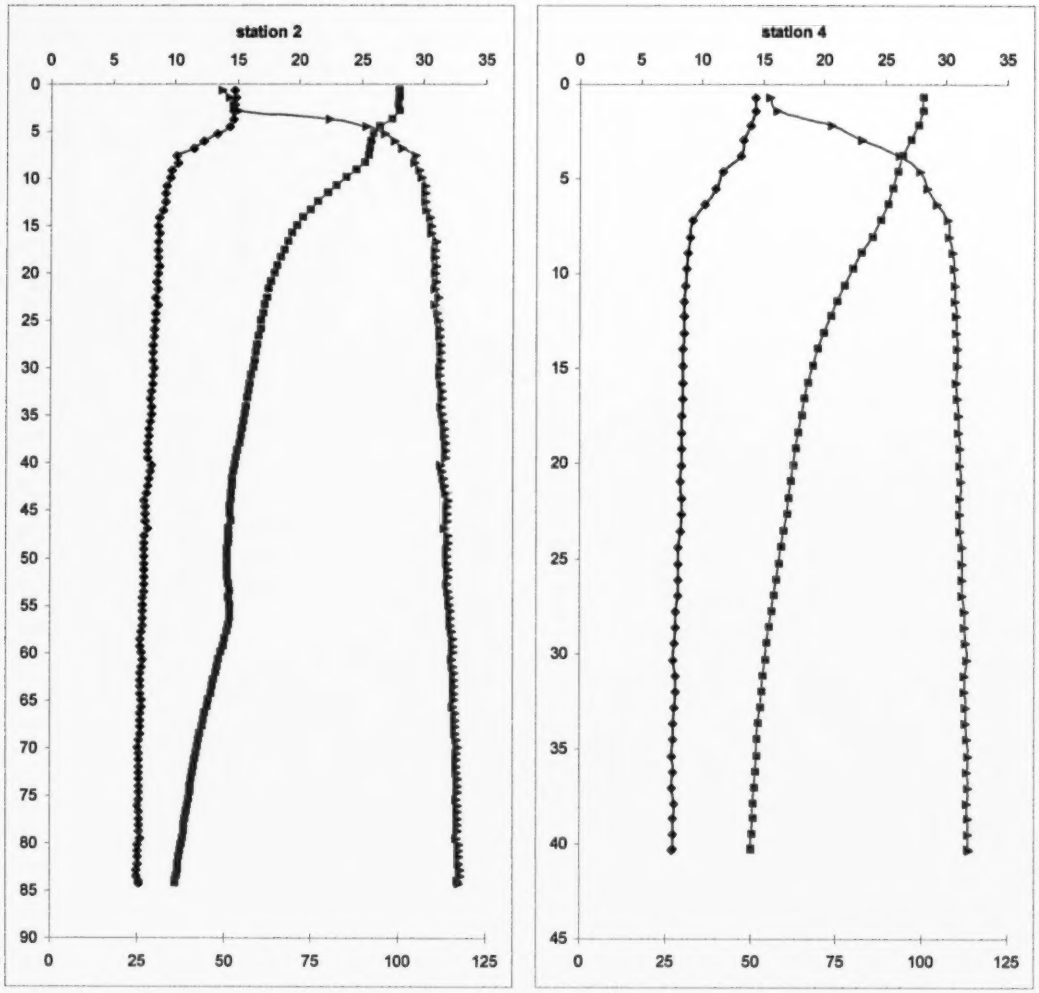



Figure 9 continued…

Table 1. Summary of the purse seine set locations from the 2009 Central Coast juvenile herring survey.

| Set | Year | Month | Set Day | Location | Set Code | Station | Set Start Time | DD Lat (N) | DD Long (W) |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 2009 | 8 | 9 | Kwakshua Channel | 2 | 4 | 2205 | 51.6550 | 128.1150 |
| 2 | 2009 | 8 | 10 | Burke Channel | 12 | 4 | 2220 | 52.1719 | 127.5732 |
| 3 | 2009 | 8 | 10 | Burke Channel | 12 | 6 | 2250 | 52.1820 | 127.5321 |
| 4 | 2009 | 8 | 10 | Burke Channel | 12 | 3 | 2325 | 52.1693 | 127.4946 |
| 5 | 2009 | 8 | 10 | Burke Channel | 12 | 2 | 0005 | 52.1239 | 127.4380 |
| 6 | 2009 | 8 | 10 | Burke Channel | 12 | 5 | 0040 | 52.1051 | 127.4035 |
| 7 | 2009 | 8 | 11 | Dean Channel | 13 | 5 | 2205 | 52.3297 | 127.5348 |
| 8 | 2009 | 8 | 11 | Dean Channel | 13 | 4 | 2230 | 52.3139 | 127.5398 |
| 9 | 2009 | 8 | 11 | Dean Channel | 13 | 3 | 2300 | 52.2997 | 127.5533 |
| 10 | 2009 | 8 | 11 | Dean Channel | 13 | 2 | 2325 | 52.3058 | 127.5816 |
| 11 | 2009 | 8 | 11 | Dean Channel | 13 | 1 | 2355 | 52.3181 | 127.5974 |
| 12 | 2009 | 8 | 12 | Thompson Bay | 5 | 1 | 2205 | 52.1210 | 128.4070 |
| 13 | 2009 | 8 | 12 | Thompson Bay | 5 | 2 | 2230 | 52.1340 | 128.3780 |
| 14 | 2009 | 8 | 12 | Thompson Bay | 5 | 3 | 2300 | 52.1480 | 128.3980 |
| 15 | 2009 | 8 | 12 | Thompson Bay | 5 | 5 | 2325 | 52.1587 | 128.3902 |
| 16 | 2009 | 8 | 12 | Thompson Bay | 5 | 4 | 0005 | 52.1590 | 128.3540 |
| 17 | 2009 | 8 | 13 | East Higgins Pass | 8 | 1 | 2220 | 52.4020 | 128.5580 |
| 18 | 2009 | 8 | 13 | East Higgins Pass | 8 | 2 | 2300 | 52.4360 | 128.5950 |
| 19 | 2009 | 8 | 13 | East Higgins Pass | 8 | 3 | 2340 | 52.4710 | 128.6380 |
| 20 | 2009 | 8 | 13 | East Higgins Pass | 8 | 5 | 0005 | 52.4917 | 128.6615 |
| 21 | 2009 | 8 | 13 | East Higgins Pass | 8 | 4 | 0030 | 52.4920 | 128.6930 |
| 22 | 2009 | 8 | 14 | Kitasu Bay | 7 | 1 | 2220 | 52.5500 | 128.8000 |
| 23 | 2009 | 8 | 14 | Kitasu Bay | 7 | 2 | 2250 | 52.5450 | 128.7710 |
| 24 | 2009 | 8 | 14 | Kitasu Bay | 7 | 5 | 2315 | 52.5551 | 128.7515 |
| 25 | 2009 | 8 | 14 | Kitasu Bay | 7 | 4 | 2350 | 52.5250 | 128.7510 |
| 26 | 2009 | 8 | 15 | Meyers Pass | 6 | 4 | 2220 | 52.6549 | 128.5758 |
| 27 | 2009 | 8 | 15 | Meyers Pass | 6 | 3 | 2240 | 52.6645 | 128.5621 |
| 28 | 2009 | 8 | 15 | Meyers Pass | 6 | 1 | 2305 | 52.6730 | 128.5720 |
| 29 | 2009 | 8 | 15 | Meyers Pass | 6 | 5 | 2330 | 52.6725 | 128.5994 |
| 30 | 2009 | 8 | 15 | Meyers Pass | 6 | 2 | 0000 | 52.6840 | 128.5770 |
| 31 | 2009 | 8 | 16 | Powell Anchorage | 9 | 3 | 2215 | 52.3207 | 128.3780 |
| 32 | 2009 | 8 | 16 | Powell Anchorage | 9 | 4 | 2245 | 52.3255 | 128.3442 |
| 33 | 2009 | 8 | 16 | Powell Anchorage | 9 | 5 | 2310 | 52.3117 | 128.3587 |
| 34 | 2009 | 8 | 16 | Powell Anchorage | 9 | 1 | 2335 | 52.2910 | 128.3760 |
| 35 | 2009 | 8 | 16 | Powell Anchorage | 9 | 2 | 0000 | 52.2840 | 128.3550 |

Table 1 continued...

| Set | Year | Month | Set Day | Location | Set Code | Station | Set Start Time | DD Lat (N) | DD Long (W) |
|---|---|---|---|---|---|---|---|---|---|
| 36 | 2009 | 8 | 17 | Spiller Channel | 10 | 3 | 2155 | 52.2770 | 128.2350 |
| 37 | 2009 | 8 | 17 | Spiller Channel | 10 | 4 | 2220 | 52.2900 | 128.2590 |
| 38 | 2009 | 8 | 17 | Spiller Channel | 10 | 2 | 2250 | 52.2680 | 128.2710 |
| 39 | 2009 | 8 | 17 | Spiller Channel | 10 | 1 | 2320 | 52.2500 | 128.2740 |
| 40 | 2009 | 8 | 17 | Spiller Channel | 10 | 5 | 2355 | 52.2632 | 128.3357 |
| 41 | 2009 | 8 | 18 | Hunter Channel | 11 | 1 | 2205 | 52.0570 | 128.1150 |
| 42 | 2009 | 8 | 18 | Hunter Channel | 11 | 2 | 2240 | 52.0570 | 128.1410 |
| 43 | 2009 | 8 | 18 | Hunter Channel | 11 | 5 | 2305 | 52.0660 | 128.1594 |
| 44 | 2009 | 8 | 18 | Hunter Channel | 11 | 3 | 2325 | 52.0730 | 128.1350 |
| 45 | 2009 | 8 | 18 | Hunter Channel | 11 | 4 | 2350 | 52.0780 | 128.1530 |
| 46 | 2009 | 8 | 19 | Kildidt Sound | 4 | 3 | 2200 | 51.8370 | 128.1540 |
| 47 | 2009 | 8 | 19 | Kildidt Sound | 4 | 4 | 2230 | 51.8500 | 128.1160 |
| 48 | 2009 | 8 | 19 | Kildidt Sound | 4 | 1 | 2300 | 51.8620 | 128.1460 |
| 49 | 2009 | 8 | 19 | Kildidt Sound | 4 | 5 | 2325 | 51.8734 | 128.1317 |
| 50 | 2009 | 8 | 19 | Kildidt Sound | 4 | 2 | 2355 | 51.8790 | 128.1590 |
| 51 | 2009 | 8 | 20 | Fish Egg Inlet | 1 | 1 | 2145 | 51.6210 | 127.7450 |
| 52 | 2009 | 8 | 20 | Fish Egg Inlet | 1 | 2 | 2215 | 51.6040 | 127.7730 |
| 53 | 2009 | 8 | 20 | Fish Egg Inlet | 1 | 5 | 2245 | 51.6320 | 127.7770 |
| 54 | 2009 | 8 | 20 | Fish Egg Inlet | 1 | 3 | 2320 | 51.6170 | 127.8320 |
| 55 | 2009 | 8 | 20 | Fish Egg Inlet | 1 | 4 | 2350 | 51.6470 | 127.8280 |
| 56 | 2009 | 8 | 21 | Rivers Inlet | 14 | 3 | 2140 | 51.5922 | 127.5678 |
| 57 | 2009 | 8 | 21 | Rivers Inlet | 14 | 5 | 2210 | 51.5652 | 127.5892 |
| 58 | 2009 | 8 | 21 | Rivers Inlet | 14 | 4 | 2235 | 51.5724 | 127.5752 |
| 59 | 2009 | 8 | 21 | Rivers Inlet | 14 | 2 | 2300 | 51.5795 | 127.5490 |
| 60 | 2009 | 8 | 21 | Rivers Inlet | 14 | 1 | 2330 | 51.5570 | 127.5555 |

Table 2. Summary of the number and weight by species, transect, and station from the 2009 Central Coast juvenile herring survey.

| Set | Set Code | Station | Location Name | Species | Number | Weight (kg)* |
|---|---|---|---|---|---|---|
| 1 | 2 | 4 | Kwakshua Channel | **Pacific herring age-1+** | 1 | 0.02 |
| | | | | Chinook salmon | 2 | 0.04 |
| | | | | Pink salmon | 1 | 0.02 |
| | | | | Sockeye salmon | 1 | 0.60 |
| 2 | 12 | 4 | Burke Channel | **Pacific herring age-1+** | 1025 | 12.81 |
| | | | | **Pacific herring age-2+** | 5 | 0.25 |
| | | | | Chinook salmon | 5 | 0.03 |
| 3 | 12 | 6 | Burke Channel | **Pacific herring age-1+** | 1015 | 13.40 |
| | | | | Chinook salmon | 15 | 0.23 |
| 4 | 12 | 3 | Burke Channel | **Pacific herring age-1+** | 82 | 1.04 |
| | | | | **Pacific herring age-2+** | 1 | 0.05 |
| | | | | Northern anchovy | 1 | 0.01 |
| | | | | Three-spine stickleback | 1 | trace |
| 5 | 12 | 2 | Burke Channel | **Pacific herring age-0+** | 77 | 0.51 |
| | | | | **Pacific herring age-1+** | 4675 | 55.68 |
| | | | | **Pacific herring age-2+** | 22 | 0.89 |
| | | | | Three-spine stickleback | 121 | 0.14 |
| | | | | Northern anchovy | 22 | 0.42 |
| | | | | Spiny dogfish | 1 | 0.50 |
| 6 | 12 | 5 | Burke Channel | **Pacific herring age-0+** | 104 | 0.59 |
| | | | | **Pacific herring age-1+** | 150 | 1.47 |
| | | | | Three-spine stickleback | 19 | 0.02 |
| | | | | Spiny dogfish | 14 | 7.00 |
| | | | | Capelin | 1 | trace |
| | | | | Chinook salmon | 1 | 0.01 |
| | | | | Coho salmon | 1 | 0.01 |
| | | | | Pacific sardine | 1 | 0.19 |
| | | | | Chum salmon | 1 | 1.50 |

* Weights ≤ 9g referred to as trace

Table 2 continued...

| Set | Set Code | Station | Location Name | Species | Number | Weight (kg)* |
|---|---|---|---|---|---|---|
| 7 | 13 | 5 | Dean Channel | **Pacific herring age-0+** | 2 | 0.01 |
| | | | | **Pacific herring age-1+** | 52 | 0.65 |
| | | | | Pink salmon | 17 | 17.00 |
| | | | | Northern anchovy | 1 | 0.02 |
| | | | | Three-spine stickleback | 5 | 0.01 |
| | | | | Capelin | 1 | trace |
| 8 | 13 | 4 | Dean Channel | **Pacific herring age-0+** | 5 | 0.04 |
| | | | | **Pacific herring age-1+** | 287 | 4.43 |
| | | | | Northern anchovy | 3 | 0.05 |
| | | | | Pink salmon | 3 | 3.00 |
| | | | | Three-spine stickleback | 3 | trace |
| | | | | Pacific sardine | 2 | 0.34 |
| | | | | Capelin | 1 | trace |
| | | | | Chinook salmon | 1 | 0.01 |
| 9 | 13 | 3 | Dean Channel | **Pacific herring age-1+** | 171 | 2.38 |
| | | | | **Pacific herring age-2+** | 2 | 0.10 |
| | | | | Three-spine stickleback | 117 | 0.11 |
| | | | | Northern anchovy | 2 | 0.03 |
| | | | | Pacific sardine | 1 | 0.21 |
| | | | | Pink salmon | 1 | 1.00 |
| 10 | 13 | 2 | Dean Channel | **Pacific herring age-0+** | 24 | 0.12 |
| | | | | **Pacific herring age-1+** | 320 | 4.76 |
| | | | | **Pacific herring age-2+** | 2 | 0.08 |
| | | | | Pacific sardine | 22 | 4.45 |
| | | | | Three-spine stickleback | 12 | 0.02 |
| | | | | Pink salmon | 3 | 3.00 |
| 11 | 13 | 1 | Dean Channel | **Pacific herring age-0+** | 15 | 0.09 |
| | | | | **Pacific herring age-1+** | 768 | 11.02 |
| | | | | **Pacific herring age-2+** | 9 | 0.43 |
| | | | | Pink salmon | 6 | 6.00 |

Table 2 continued...

| Set | Set Code | Station | Location Name | Species | Number | Weight (kg)* |
|---|---|---|---|---|---|---|
| 12 | 5 | 1 | Thompson Bay | **Pacific herring age-0+** | 14 | 0.05 |
| | | | | **Pacific herring age-1+** | 24 | 0.66 |
| | | | | **Pacific herring age-2+** | 168 | 9.07 |
| | | | | Capelin | 2 | trace |
| 13 | 5 | 2 | Thompson Bay | Pacific sardine | 5282 | 1001.90 |
| 14 | 5 | 3 | Thompson Bay | **Pacific herring age-0+** | 594 | 1.80 |
| | | | | **Pacific herring age-1+** | 42 | 0.98 |
| | | | | Capelin | 2 | 0.02 |
| 15 | 5 | 5 | Thompson Bay | **Pacific herring age-0+** | 36 | 0.09 |
| | | | | **Pacific herring age-1+** | 4 | 0.10 |
| | | | | Chinook salmon | 1 | 0.08 |
| | | | | Pacific sardine | 1 | 0.18 |
| | | | | Shiner perch | 1 | 0.04 |
| 16 | 5 | 4 | Thompson Bay | **Pacific herring age-0+** | 60 | 0.18 |
| | | | | **Pacific herring age-1+** | 136 | 2.42 |
| | | | | **Pacific herring age-2+** | 2 | 0.10 |
| | | | | Squid | 13 | 0.19 |
| | | | | Shiner perch | 8 | 0.04 |
| | | | | Pacific sardine | 4 | 0.79 |
| | | | | Northern anchovy | 1 | 0.02 |
| | | | | Chinook salmon | 1 | 0.20 |
| | | | | Three-spine stickleback | 1 | trace |
| 17 | 8 | 1 | East Higgins Pass | Pacific sardine | 46 | 8.19 |
| | | | | Pink salmon | 3 | 3.00 |
| 18 | 8 | 2 | East Higgins Pass | Pacific sardine | 1345 | 251.87 |
| 19 | 8 | 3 | East Higgins Pass | Pacific sardine | 273 | 51.90 |
| 20 | 8 | 5 | East Higgins Pass | Pacific sardine | 276 | 51.88 |
| 21 | 8 | 4 | East Higgins Pass | Pacific sardine | 149 | 26.80 |

Table 2 continued...

| Set | Set Code | Station | Location Name | Species | Number | Weight (kg)* |
|---|---|---|---|---|---|---|
| 22 | 7 | 1 | Kitasu Bay | Pacific sardine | 1035 | 201.95 |
| 23 | 7 | 2 | Kitasu Bay | **Pacific herring age-1+** | 173 | 3.65 |
| | | | | Pacific sardine | 242 | 47.98 |
| | | | | Capelin | 66 | 0.52 |
| 24 | 7 | 5 | Kitasu Bay | **Pacific herring age-1+** | 833 | 17.00 |
| | | | | Pacific sardine | 198 | 39.59 |
| | | | | Capelin | 2 | 0.02 |
| 25 | 7 | 4 | Kitasu Bay | **Pacific herring age-1+** | 1 | 0.02 |
| | | | | Pacific sardine | 13 | 2.56 |
| | | | | Chinook salmon | 1 | 0.20 |
| 26 | 6 | 4 | Meyers Pass | **Pacific herring age-0+** | 208 | 0.23 |
| | | | | **Pacific herring age-1+** | 20 | 0.27 |
| | | | | **Pacific herring age-2+** | 1 | 0.03 |
| | | | | Capelin | 53 | 0.04 |
| 27 | 6 | 3 | Meyers Pass | **Pacific herring age-0+** | 1292 | 1.92 |
| | | | | **Pacific herring age-1+** | 32 | 0.51 |
| | | | | Chum salmon | 4 | 0.02 |
| 28 | 6 | 1 | Meyers Pass | **Pacific herring age-0+** | 112 | 0.018 |
| | | | | **Pacific herring age-1+** | 10 | 0.11 |
| 29 | 6 | 5 | Meyers Pass | **Pacific herring age-0+** | 5126 | 12.16 |
| | | | | **Pacific herring age-1+** | 814 | 14.12 |
| | | | | Capelin | 132 | 0.06 |
| 30 | 6 | 2 | Meyers Pass | **Pacific herring age-0+** | 99 | 0.18 |
| | | | | **Pacific herring age-1+** | 29 | 0.39 |
| | | | | **Pacific herring age-2+** | 1 | 0.04 |
| | | | | Capelin | 14 | 0.01 |

Table 2 continued...

| Set | Set Code | Station | Location Name | Species | Number | Weight (kg)* |
|---|---|---|---|---|---|---|
| 31 | 9 | 3 | Powell Anchorage | **Pacific herring age-0+** | 45 | 0.15 |
| | | | | **Pacific herring age-1+** | 445 | 10.41 |
| | | | | **Pacific herring age-2+** | 15 | 0.65 |
| | | | | Capelin | 1080 | 4.60 |
| 32 | 9 | 4 | Powell Anchorage | **Pacific herring age-0+** | 12675 | 39.16 |
| | | | | **Pacific herring age-1+** | 5250 | 82.85 |
| 33 | 9 | 5 | Powell Anchorage | **Pacific herring age-0+** | 15996 | 49.39 |
| | | | | **Pacific herring age-1+** | 217 | 3.12 |
| 34 | 9 | 1 | Powell Anchorage | **Pacific herring age-0+** | 1776 | 4.51 |
| 35 | 9 | 2 | Powell Anchorage | **Pacific herring age-0+** | 749 | 1.83 |
| | | | | **Pacific herring age-1+** | 55 | 0.78 |
| | | | | Pacific sardine | 2712 | 256.19 |
| 36 | 10 | 3 | Spiller Channel | Pacific sardine | 349 | 52.00 |
| 37 | 10 | 4 | Spiller Channel | **Pacific herring age-0+** | 1780 | 7.05 |
| | | | | Pacific sardine | 5042 | 999.71 |
| 38 | 10 | 2 | Spiller Channel | **Pacific herring age-0+** | 935 | 5.02 |
| | | | | **Pacific herring age-1+** | 36574 | 752.93 |
| | | | | **Pacific herring age-2+** | 243 | 8.03 |
| | | | | Pacific sardine | 1285 | 240.94 |
| 39 | 10 | 1 | Spiller Channel | **Pacific herring age-1+** | 95 | 2.09 |
| | | | | **Pacific herring age-2+** | 54 | 2.08 |
| | | | | Pacific sardine | 256 | 47.87 |
| 40 | 10 | 5 | Spiller Channel | **Pacific herring age-0+** | 1416 | 5.62 |
| | | | | **Pacific herring age-1+** | 66 | 1.46 |
| | | | | **Pacific herring age-2+** | 18 | 0.92 |
| | | | | Juvenile walleye pollock | 72 | 5.35 |

Table 2 continued...

| Set | Set Code | Station | Location Name | Species | Number | Weight (kg)* |
|---|---|---|---|---|---|---|
| 41 | 11 | 1 | Hunter Channel | **Pacific herring age-0+** | 813 | 2.03 |
| | | | | **Pacific herring age-1+** | 772 | 10.13 |
| | | | | Pacific sardine | 5407 | 994.71 |
| 42 | 11 | 2 | Hunter Channel | **Pacific herring age-0+** | 35739 | 88.50 |
| | | | | **Pacific herring age-1+** | 1441 | 24.94 |
| | | | | Pacific sardine | 466 | 89.72 |
| | | | | Coho salmon | 49 | 1.22 |
| 43 | 11 | 5 | Hunter Channel | **Pacific herring age-0+** | 2079 | 4.93 |
| | | | | **Pacific herring age-1+** | 665 | 10.27 |
| | | | | **Pacific herring age-2+** | 21 | 0.94 |
| | | | | Shiner perch | 49 | 0.15 |
| 44 | 11 | 3 | Hunter Channel | **Pacific herring age-0+** | 32 | 0.11 |
| | | | | **Pacific herring age-1+** | 205 | 3.39 |
| | | | | Pacific sardine | 537 | 109.45 |
| | | | | Chinook salmon | 6 | 0.24 |
| 45 | 11 | 4 | Hunter Channel | **Pacific herring age-0+** | 2360 | 7.67 |
| | | | | **Pacific herring age-1+** | 1940 | 24.02 |
| | | | | **Pacific herring age-2+** | 33 | 1.03 |
| | | | | Pacific sardine | 2537 | 477.86 |
| 46 | 4 | 3 | Kildidt Sound | Pacific sardine | 2843 | 501.77 |
| 47 | 4 | 4 | Kildidt Sound | **Pacific herring age-0+** | 2780 | 4.25 |
| | | | | **Pacific herring age-1+** | 16 | 0.23 |
| | | | | Coho salmon | 4 | 0.59 |
| 48 | 4 | 1 | Kildidt Sound | **Pacific herring age-0+** | 83 | 0.12 |
| | | | | **Pacific herring age-1+** | 9 | 0.11 |
| | | | | **Pacific herring age-2+** | 11 | 0.66 |
| | | | | Pacific sardine | 591 | 108.35 |
| | | | | Coho salmon | 1 | 4.00 |

Table 2 continued...

| Set | Set Code | Station | Location Name | Species | Number | Weight (kg)* |
|---|---|---|---|---|---|---|
| 49 | 4 | 5 | Kildidt Sound | **Pacific herring age-0+** | 833 | 1.38 |
| | | | | **Pacific herring age-1+** | 53 | 0.97 |
| | | | | **Pacific herring age-2+** | 1 | 0.04 |
| | | | | Pacific sardine | 2 | 0.38 |
| | | | | Coho salmon | 1 | 0.02 |
| | | | | Three-spine stickleback | 1 | trace |
| 50 | 4 | 2 | Kildidt Sound | **Pacific herring age-0+** | 427 | 0.36 |
| | | | | Capelin | 39 | 0.03 |
| | | | | Pacific sardine | 7 | 1.21 |
| | | | | Squid | 7 | 0.06 |
| | | | | Juvenile walleye pollock | 5 | 0.24 |
| | | | | Chinook salmon | 1 | 0.10 |
| | | | | Shiner perch | 1 | trace |
| 51 | 1 | 1 | Fish Egg Inlet | **Pacific herring age-1+** | 84 | 2.12 |
| | | | | **Pacific herring age-2+** | 8 | 0.33 |
| | | | | Juvenile walleye pollock | 8 | 0.04 |
| | | | | Northern anchovy | 6 | 0.09 |
| | | | | Pacific sardine | 4 | 0.84 |
| | | | | Capelin | 2 | trace |
| 52 | 1 | 2 | Fish Egg Inlet | **Pacific herring age-0+** | 400 | 2.27 |
| | | | | **Pacific herring age-1+** | 2144 | 35.52 |
| | | | | Coho salmon | 1 | 2.80 |
| 53 | 1 | 5 | Fish Egg Inlet | **Pacific herring age-0+** | 1308 | 4.70 |
| | | | | **Pacific herring age-1+** | 2320 | 39.37 |
| | | | | **Pacific herring age-2+** | 92 | 3.14 |
| | | | | Pacific sardine | 656 | 110.21 |
| 54 | 1 | 3 | Fish Egg Inlet | **Pacific herring age-0+** | 91 | 0.34 |
| | | | | **Pacific herring age-1+** | 1417 | 22.74 |
| | | | | **Pacific herring age-2+** | 39 | 1.55 |
| | | | | Pacific sardine | 182 | 30.89 |
| | | | | Juvenile walleye pollock | 26 | 1.90 |
| | | | | Capelin | 13 | 0.01 |
| | | | | Chinook salmon | 1 | 1.90 |

Table 2 continued...

| Set | Set Code | Station | Location Name | Species | Number | Weight (kg)* |
|---|---|---|---|---|---|---|
| 55 | 1 | 4 | Fish Egg Inlet | **Pacific herring age-0+** | 899 | 4.43 |
| | | | | **Pacific herring age-1+** | 7946 | 118.63 |
| | | | | Pacific sardine | 87 | 16.69 |
| 56 | 14 | 3 | Rivers Inlet | **Pacific herring age-1+** | 1617 | 28.64 |
| | | | | **Pacific herring age-2+** | 11 | 0.48 |
| | | | | Capelin | 22 | 0.13 |
| | | | | Chinook salmon | 11 | 0.33 |
| 57 | 14 | 5 | Rivers Inlet | **Pacific herring age-0+** | 66 | 0.16 |
| | | | | **Pacific herring age-1+** | 1628 | 32.20 |
| | | | | **Pacific herring age-2+** | 44 | 1.79 |
| | | | | Capelin | 11 | 0.01 |
| | | | | Three-spine stickleback | 11 | 0.03 |
| 58 | 14 | 4 | Rivers Inlet | **Pacific herring age-0+** | 272 | 0.69 |
| | | | | **Pacific herring age-1+** | 3440 | 57.60 |
| | | | | Capelin | 320 | 0.21 |
| | | | | Chinook salmon | 16 | 0.43 |
| 59 | 14 | 2 | Rivers Inlet | **Pacific herring age-1+** | 57 | 1.08 |
| | | | | Pacific sardine | 526 | 106.38 |
| | | | | Pink salmon | 1 | 1.00 |
| | | | | Capelin | 3 | trace |
| | | | | Sockeye salmon | 1 | trace |
| | | | | Three-spine stickleback | 1 | trace |
| 60 | 14 | 1 | Rivers Inlet | **Pacific herring age-0+** | 2 | trace |
| | | | | **Pacific herring age-1+** | 64 | 1.04 |
| | | | | **Pacific herring age-2+** | 2 | 0.11 |
| | | | | Capelin | 44 | 0.03 |
| | | | | Pacific sardine | 30 | 5.61 |
| | | | | Three-spine stickleback | 26 | 0.02 |
| | | | | Chinook salmon | 2 | 0.05 |
| | | | | Chum salmon | 2 | 0.03 |
| | | | | Juvenile hake | 2 | 0.08 |

Table 3. Percent occurrence by species in purse seine sets from the 2009 Central Coast juvenile herring survey.

| Species Caught | | |
|---|---|---|
| **Common Name** | **Scientific Name** | **% Occurrence** |
| Pacific herring age-0+ | *Clupea pallasi* in year of birth | 65.00 |
| Pacific herring age-1+ | *Clupea pallasi* in first year | 80.00 |
| Pacific herring age-2+ | *Clupea pallasi* in second or more years | 40.00 |
| Capelin | *Mallotus villosus* | 31.67 |
| Chinook salmon | *Oncorhynchus tshawytscha* | 23.33 |
| Chum salmon | *Oncorhynchus keta* | 5.00 |
| Coho salmon | *Oncorhynchus kisutch* | 10.00 |
| Juvenile hake | *Merluccius productus* | 1.67 |
| Juvenile pollock | *Theragra chalcogramma* | 6.67 |
| Northern anchovy | *Engraulis mordax mordax* | 11.67 |
| Pacific sardine | *Sardinops sagax* | 58.33 |
| Pink salmon | *Oncorhynchus gorbuscha* | 13.33 |
| Shiner perch | *Cymatogaster aggregata* | 6.67 |
| Sockeye salmon | *Onchorhynchus nerka* | 3.33 |
| Spiny dogfish | *Squalus acanthias* | 3.33 |
| Squid | *Loligo opalescens* or *Gonatus fabricii* | 3.33 |
| Three-spine stickleback | *Gasterosteus aculeatus* | 20.00 |

Table 4. Summary of the number of herring sampled including length and weight (range, mean, and standard deviations) for each of the three herring age classes encountered. Total catch in numbers (N) and weight (Wt) of all herring by transect for the 2008 Central Coast juvenile herring survey.

| Age-0+ | | | Length (mm) | | | Weight (g) | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Location Name | Set Code | Sampled | Range | Mean | STDev | Range | Mean | STDev | Catch | Total Catch Weight (kg) |
| Fish Egg Inlet | 1 | 97 | 60-80 | 71 | 4.72 | 2.38-6.95 | 4.27 | 1.13 | 2698 | 11.73 |
| Kwakshua | 2 | - | - | - | - | - | - | - | - | - |
| Kildidt Sound | 4 | 312 | 28-66 | 48 | 7.14 | 0.20-3.12 | 1.35 | 0.55 | 4123 | 6.12 |
| Thompson Bay | 5 | 203 | 47-80 | 62 | 5.96 | 0.99-6.20 | 2.95 | 0.90 | 704 | 2.12 |
| Meyers Passage | 6 | 502 | 33-82 | 52 | 7.24 | 0.37-6.63 | 1.70 | 0.75 | 6837 | 146.81 |
| Kitasu Bay | 7 | - | - | - | - | - | - | - | - | - |
| East Higgins Pass | 8 | - | - | - | - | - | - | - | - | - |
| Powell Anchorage | 9 | 341 | 47-75 | 61 | 4.79 | 1.21-4.97 | 2.87 | 0.66 | 31241 | 95.03 |
| Spiller Channel | 10 | 116 | 53-80 | 68 | 5.19 | 2.04-6.43 | 4.02 | 0.88 | 4131 | 17.69 |
| Hunter Channel | 11 | 270 | 48-82 | 61 | 5.52 | 1.39-6.21 | 2.58 | 0.81 | 41023 | 103.24 |
| Burke Channel | 12 | 34 | 49-82 | 75 | 7.77 | 1.75-7.67 | 5.69 | 1.32 | 181 | 1.09 |
| Dean Channel | 13 | 8 | 68-82 | 76 | 5.55 | 4.02-6.96 | 5.64 | 1.07 | 46 | 0.26 |
| Rivers Inlet | 14 | 24 | 46-78 | 59 | 8.78 | 0.94-5.57 | 2.47 | 1.24 | 340 | 0.85 |
| **TOTALS** | | 1907 | 28-82 | 58 | 9.56 | 0.20-7.67 | 2.49 | 1.25 | 91324 | 384.94 |

Table 4 continued…

| Age-1+ | | | Length (mm) | | | Weight (g) | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Location Name | Set Code | Sampled | Range | Mean | STDev | Range | Mean | STDev | Catch | Total Catch Weight (kg) |
| Fish Egg Inlet | 1 | 457 | 83-138 | 109 | 9.07 | 7.14-37.16 | 17.00 | 4.69 | 13911 | 218.37 |
| Kwakshua Channel | 2 | 1 | - | 114 | - | - | 19.29 | - | 1 | 0.02 |
| Kildidt Sound | 4 | 58 | 85-138 | 109 | 13.48 | 6.72-42.99 | 17.92 | 7.93 | 78 | 1.31 |
| Thompson Bay | 5 | 137 | 88-137 | 112 | 10.78 | 9.63-39.32 | 19.93 | 5.43 | 206 | 4.16 |
| Meyers Passage | 6 | 141 | 85-137 | 106 | 14.11 | 6.96-31.18 | 15.46 | 6.43 | 905 | 153.96 |
| Kitasu Bay | 7 | 106 | 91-136 | 117 | 7.36 | 8.67-32.14 | 20.48 | 3.99 | 1007 | 20.67 |
| East Higgins Pass | 8 | - | - | - | - | - | - | - | - | - |
| Powell Anchorage | 9 | 198 | 86-135 | 112 | 10.32 | 8.21-32.19 | 19.15 | 5.22 | 5967 | 97.16 |
| Spiller Channel | 10 | 110 | 98-137 | 116 | 8.12 | 11.95-35.62 | 20.77 | 4.25 | 36735 | 756.48 |
| Hunter Channel | 11 | 202 | 83-136 | 106 | 12.08 | 5.69-34.38 | 15.11 | 5.64 | 5023 | 72.74 |
| Burke Channel | 12 | 446 | 83-136 | 97 | 6.72 | 6.34-38.66 | 12.16 | 2.94 | 6947 | 84.40 |
| Dean Channel | 13 | 447 | 84-136 | 102 | 10.16 | 6.89-38.99 | 14.42 | 4.91 | 1598 | 23.25 |
| Rivers Inlet | 14 | 331 | 84-138 | 111 | 9.49 | 7.53-36.32 | 17.92 | 5.14 | 6806 | 120.55 |
| **TOTALS** | | 2634 | 83-138 | 107 | 11.38 | 5.69-42.99 | 16.26 | 5.53 | 79184 | 1553.07 |

Table 4 continued...

| Age-2+ | | | Length (mm) | | | Weight (g) | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Location Name | Set Code | Sampled | Range | Mean | STDev | Range | Mean | STDev | Catch | Total Catch Weight (kg) |
| Fish Egg Inlet | 1 | 11 | 139-151 | 143 | 4.36 | 31.12-46.87 | 38.3 | 4.99 | 139 | 5.01 |
| Kwakshua Channel | 2 | - | - | - | - | - | - | - | - | - |
| Kildidt Sound | 4 | 2 | 139-159 | 149 | 14.14 | 36.70-61.30 | 49 | 17.39 | 12 | 0.70 |
| Thompson Bay | 5 | 86 | 139-183 | 156 | 11.15 | 35.86-91.18 | 53.88 | 12.56 | 170 | 9.17 |
| Meyers Passage | 6 | 2 | 147-153 | 150 | 4.24 | 32.23-43.55 | 37.89 | 8.00 | 2 | 0.76 |
| Kitasu Bay | 7 | - | - | - | - | - | - | - | - | - |
| East Higgins Pass | 8 | - | - | - | - | - | - | - | - | - |
| Powell Anchorage | 9 | 3 | 140-153 | 146 | 6.66 | 37.57-50.96 | 43.63 | 6.78 | 15 | 0.65 |
| Spiller Channel | 10 | 6 | 139-174 | 147 | 13.65 | 33.12-70.03 | 43.95 | 13.19 | 315 | 11.03 |
| Hunter Channel | 11 | 4 | 139-155 | 149 | 7.12 | 31.23-47.49 | 41.54 | 7.18 | 54 | 1.98 |
| Burke Channel | 12 | 3 | 143-149 | 147 | 3.46 | 40.97-50.21 | 46.07 | 4.69 | 28 | 1.19 |
| Dean Channel | 13 | 5 | 141-153 | 147 | 4.28 | 42.03-53.66 | 48.57 | 4.58 | 13 | 0.62 |
| Rivers Inlet | 14 | 6 | 140-157 | 145 | 6.74 | 33.49-55.31 | 43.55 | 8.88 | 57 | 2.38 |
| **TOTALS** | | 128 | 139-183 | 153 | 11.14 | 31.12-91.18 | 50.25 | 12.45 | 805 | 33.48 |

Table 5. Grouping of organisms, by phylum with abbreviations from plankton tows from the 2009 Central Coast juvenile herring survey.

| | |
|---|---|
| **Coelenterata** | |
| **COEL** | Medusae - *Aequorea victoria* |
| **SIPH** | Siphonophores |
| **Ctenophora** | |
| **CTEN** | Ctenophores |
| **Annelida** | |
| **POLY** | Polychaetes |
| **Mollusca** | |
| **GAST** | Prosobranch gastropods |
| **MUSS** | Mussels |
| **OCTO** | Octopus larvae |
| **PELE** | Pelecypods |
| **Arthropoda** | |
| **AMPH** | Amphipods |
| **BARN** | Barnacle; unknown stage |
| **CAPR** | Skeleton shrimp (*Caprellida sp.*) |
| **CLAD** | Cladocerans; Podon sp. and Evadne sp. |
| **COPE** | Copepods (Table 6 for complete species list) |
| **CNAU** | Unidentified copepod nauplii |
| **CRAM** | Crab megalopea |
| **CRAZ** | Crab zoea |
| **EUPA** | Adult euphausiids; mainly *Euphausia pacifica* |
| **EUPH** | *Euphausia pacifica* |
| **EUPL** | Larval euphausiids; mainly *Euphausia pacifica* |
| **MYSI** | Mysids |
| **OSTR** | Ostracods |
| **SEAL** | *Caligus elongatus* |
| **SHRI** | Shrimp zoea |
| **Ectoprocta** | |
| **ECTO** | Ectoprocts; mostly *Membranipora sp.* larvae (cyphonautes) |
| **Echinodermata** | |
| **ECHI** | Echinoderm larvae |
| **Chaetognatha** | |
| **CHAE** | Chaetognaths; mostly *Sagitta sp.* |
| **Chordata** | |
| **LARV** | Larvaceans; mostly *Oikopluera sp.* and *Fritillaria sp.* |
| **FISHL** | Larval fish; unknown species |

Table 5 continued...

| | |
|---|---|
| **Miscellaneous** | |
| **EGGS** | Mainly euphausiid eggs, with some teleost eggs |

Table 6. Abbreviations for calanoid and cyclopoid copepods identified in plankton samples from the 2009 Central Coast juvenile herring survey.

| | |
|---|---|
| **Calanoid copepods** | |
| **ALON** | *Acartia longimeres* |
| **CABD** | *Centropages abdominalis* |
| **CALA** | *Calanus sp.* |
| **CAND** | *Candacia sp.* |
| **CCOL** | *Canadacia columbiae* |
| **CMAR** | *Calanus marshallae* |
| **CPAC** | *Calanus pacificus* |
| **EBUN** | *Eucalanus bungii* |
| **EELO** | *Eucalanus elongatus* |
| **ELON** | *Epilabidocera longipedata* |
| **EUCH** | *Euchaeta sp.* |
| **METR** | *Metridia sp.* |
| **MPAC** | *Metridia pacifica* |
| **OBOR** | *Oncaea borealis* |
| **PPAR** | *Paracalanus parvus* |
| **PSEU** | *Pseudocalanus sp.* |
| **TDIS** | *Tortanus discaudatus* |
| **UCAL** | Unidentified calanoid |
| **Cyclopoid copepods** | |
| **OATL** | *Oithona atlantica* |
| **OSIM** | *Oithona similis* |

Table 7. Number of zooplankton per set per volume ($m^3$) of water observed in samples from the 2009 Central Coast juvenile herring survey.

| Location | Set Code | Station | Volume | ALON | AMPH | BARN | CABD | CALA | CAND | CAPR | CCOL | CHAE |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Fish Egg Inlet | 1 | 1 | 13.8428 | 50.9 | - | 20.8 | 48.5 | 23.7 | - | - | - | 3.5 |
| | | 2 | 14.4272 | 144.2 | 0.1 | 13.4 | 54.9 | 0.3 | - | - | - | 6.7 |
| Kwakshua Channel | 2 | 3 | 16.0362 | 227.6 | 1.0 | 44.9 | 10.4 | - | - | - | - | 0.1 |
| | | 4 | 12.6924 | 162.6 | - | 8.8 | 16.2 | 95.8 | - | - | - | |
| Kildidt Sound | 4 | 3 | 13.8116 | 41.7 | 2.5 | 67.2 | 111.2 | 31.0 | - | - | - | 4.6 |
| | | 4 | 14.3853 | 100.1 | - | 15.6 | 108.1 | 6.7 | - | - | - | 2.2 |
| Thompson Bay | 5 | 1 | 14.7212 | 488.1 | - | 13.0 | 164.3 | 31.2 | - | - | - | - |
| | | 3 | 14.7875 | 48.5 | - | 7.6 | 17.4 | - | - | - | - | - |
| Meyers Pass | 6 | 1 | 14.1140 | 325.1 | 2.3 | 36.3 | 16.3 | - | - | 0.1 | - | - |
| | | 4 | 15.1860 | 466.9 | 4.5 | 126.4 | 47.2 | - | - | - | - | - |
| Kitasu Bay | 7 | 1 | 13.3705 | 753.5 | - | - | 19.1 | 2.8 | - | - | - | - |
| | | 2 | 15.2804 | 988.5 | - | - | 50.3 | 24.7 | - | - | - | - |
| East Higgins Pass | 8 | 1 | 14.3761 | 235.9 | 3.3 | - | - | 15.7 | 2.2 | - | - | 1.4 |
| | | 4 | 13.4969 | 170.7 | - | 10.3 | 183.0 | 0.3 | - | - | - | - |
| Powell Anchorage | 9 | 3 | 14.6755 | 316.2 | 2.6 | 43.6 | 40.2 | 0.3 | - | - | - | 0.1 |
| | | 4 | 14.0203 | 116.4 | - | 5.8 | 29.9 | - | - | - | - | - |
| Spiller Channel | 10 | 3 | 15.8815 | 152.1 | - | 24.2 | 20.1 | 2.5 | - | - | 0.1 | - |
| | | 4 | 15.9021 | 169.0 | - | 6.0 | 46.3 | - | - | 0.1 | - | - |
| Hunter Channel | 11 | 1 | 15.2111 | 513.3 | 0.4 | 113.7 | 131.7 | 9.2 | - | - | - | - |
| | | 3 | 15.2050 | 193.6 | 2.1 | 35.8 | 69.5 | 24.3 | - | - | - | - |
| Burke Channel | 12 | 3 | 10.5052 | 28.9 | - | 1.5 | - | - | - | - | - | - |
| | | 4 | 12.3824 | 35.9 | - | 10.3 | - | - | - | - | - | - |
| Dean Channel | 13 | 4 | 16.1253 | 56.6 | 5.0 | 0.5 | 1.9 | - | - | - | - | - |
| | | 5 | 14.8347 | 3.6 | 0.5 | 0.1 | - | 0.1 | - | - | - | - |
| Rivers Inlet | 14 | 2 | 14.6702 | 41.4 | 1.2 | 15.3 | 3.3 | 0.1 | - | - | - | 0.4 |
| | | 4 | 15.6972 | 13.8 | - | 7.5 | - | 0.2 | - | - | - | 0.3 |

Table 7 continued…

| Set Code | Station | CLAD | CMAR | CNAU | COEL | CPAC | CRAM | CRAZ | CTEN | EBUN | ECHI | ECTO | EELO |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1 | 196.5 | 0.6 | - | - | 0.6 | 0.1 | 1.3 | - | - | - | 25.4 | - |
| | 2 | 93.2 | - | - | 5.2 | 0.1 | 0.1 | 6.7 | 0.4 | - | - | 24.4 | - |
| 2 | 3 | - | - | - | - | - | - | 9.8 | 0.1 | - | - | 19.0 | - |
| | 4 | 3.8 | 1.3 | - | - | - | - | 0.3 | - | - | - | - | - |
| 4 | 3 | 39.4 | 0.3 | - | 7.0 | 2.5 | - | 3.2 | 0.1 | - | - | 4.6 | - |
| | 4 | 71.2 | - | - | 24.6 | 0.3 | 0.3 | 13.3 | 0.1 | - | - | 8.9 | - |
| 5 | 1 | - | - | - | - | 0.8 | 0.5 | 29.6 | - | - | - | 4.3 | - |
| | 3 | 2.7 | - | - | 0.8 | - | - | 6.3 | - | - | - | 2.7 | - |
| 6 | 1 | 52.1 | - | - | 0.6 | - | 0.1 | 1.0 | 0.1 | - | 2.3 | - | - |
| | 4 | 96.9 | - | 4.2 | 0.5 | - | 0.1 | 3.4 | 0.5 | - | 4.2 | 8.4 | - |
| 7 | 1 | 4.8 | - | 4.8 | 0.2 | - | - | 2.8 | - | - | - | 9.6 | - |
| | 2 | - | 0.1 | - | - | - | - | 0.1 | - | - | - | - | - |
| 8 | 1 | - | 2.2 | - | - | - | - | 0.3 | - | - | - | - | 2.2 |
| | 4 | - | - | - | 7.3 | - | 0.1 | 34.7 | - | - | - | - | - |
| 9 | 3 | 141.7 | 3.5 | - | - | - | 0.1 | 11.3 | 2.6 | - | - | - | - |
| | 4 | 87.9 | - | - | 3.4 | - | 0.2 | 17.0 | 0.2 | - | - | 1.1 | - |
| 10 | 3 | 80.6 | 0.1 | - | - | 1.0 | - | 0.2 | - | - | - | 4.0 | - |
| | 4 | 24.1 | - | - | - | - | - | 12.5 | 0.2 | - | - | 10.1 | - |
| 11 | 1 | 42.1 | - | - | - | - | - | 13.7 | 0.3 | - | - | 8.4 | - |
| | 3 | 67.3 | - | - | 0.2 | - | - | 1.3 | 0.2 | - | - | 2.1 | - |
| 12 | 3 | 71.6 | - | - | 6.9 | - | - | 3.8 | 74.6 | - | - | 1.5 | - |
| | 4 | 333.4 | - | - | 3.9 | - | - | 0.6 | 30.7 | 1.0 | 10.3 | - | 1.6 |
| 13 | 4 | 61.0 | - | - | 0.5 | - | - | 0.1 | 0.1 | - | - | - | - |
| | 5 | 16.0 | - | - | 0.4 | - | - | 0.1 | 0.8 | 0.1 | - | - | - |
| 14 | 2 | 34.9 | - | - | 1.4 | - | - | - | - | 2.2 | - | - | - |
| | 4 | 16.8 | - | - | 0.1 | - | - | 0.5 | - | 0.7 | - | 0.5 | - |

Table 7 continued…

| Set Code | Station | EGGS | ELON | EUCH | EUPA | EUPH | EUPL | FISHL | GAST | LARV | METR | MPAC | MUSS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1 | 55.5 | - | - | 1.0 | - | 4.5 | 0.1 | 11.6 | 6.9 | - | 98.2 | - |
| | 2 | - | - | - | - | - | 2.4 | - | 17.7 | - | - | - | - |
| 2 | 3 | 3.1 | - | - | - | - | 7.0 | 0.1 | - | 16.0 | - | - | - |
| | 4 | 18.9 | - | - | - | 0.3 | 9.7 | 0.2 | - | 3.8 | - | 53.6 | - |
| 4 | 3 | 41.7 | - | - | 1.2 | - | 64.7 | - | 13.9 | 20.9 | - | - | - |
| | 4 | 2.2 | - | - | - | - | 18.5 | - | 8.9 | 13.3 | - | - | - |
| 5 | 1 | 82.6 | 0.6 | - | 1.6 | - | 154.3 | 0.3 | - | 8.7 | - | 0.3 | - |
| | 3 | 5.4 | - | - | - | - | 20.9 | 0.1 | 4.9 | 28.7 | - | - | - |
| 6 | 1 | 11.4 | - | - | - | - | 39.6 | 0.1 | - | 56.7 | - | 0.1 | - |
| | 4 | 8.4 | - | - | - | - | 69.9 | - | - | 84.3 | - | - | - |
| 7 | 1 | 186.7 | - | - | - | - | 76.6 | 0.1 | 4.8 | 33.5 | - | - | - |
| | 2 | 259.7 | - | - | - | - | 25.1 | - | 41.9 | 16.8 | - | - | - |
| 8 | 1 | 342.8 | - | 2.2 | 3.3 | - | 2.5 | 0.3 | - | 4.5 | - | 300.5 | - |
| | 4 | 2.4 | - | - | - | - | 2.4 | - | 4.7 | 7.1 | - | - | - |
| 9 | 3 | 143.9 | 0.1 | - | 1.2 | - | 15.4 | - | - | 6.5 | - | 1.6 | - |
| | 4 | 18.3 | - | - | - | - | 3.7 | - | - | 5.7 | - | 0.1 | 0.1 |
| 10 | 3 | 68.5 | 0.1 | - | 0.4 | - | 13.5 | - | - | 4.0 | 7.1 | 2.2 | - |
| | 4 | 30.2 | - | - | - | - | 6.1 | - | - | 6.0 | - | 0.1 | - |
| 11 | 1 | 4.3 | - | - | - | - | 17.0 | 0.1 | 71.5 | 12.6 | - | 0.1 | - |
| | 3 | 31.6 | - | - | - | - | 10.6 | - | 12.6 | 10.5 | - | - | - |
| 12 | 3 | - | - | - | - | - | 14.8 | - | - | 150.8 | - | - | - |
| | 4 | 25.8 | - | - | - | 15.5 | 15.5 | - | - | 54.3 | - | - | - |
| 13 | 4 | - | - | - | - | - | 10.5 | - | 1.0 | 5.5 | - | - | - |
| | 5 | 0.1 | - | - | 0.2 | - | 0.7 | 0.1 | 0.1 | 0.7 | - | 0.1 | - |
| 14 | 2 | 91.6 | - | - | - | - | 9.3 | - | 4.4 | 8.9 | 1.6 | 0.4 | - |
| | 4 | 66.8 | - | - | 0.5 | - | 3.1 | - | 16.3 | 4.2 | 1.5 | - | - |

Table 7 continued…

| Set Code | Station | MYSI | OATL | OBOR | OCTO | OSIM | OSTR | PELE | POLY | PPAR | PSEU | SEAL | SHRI |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1 | - | - | - | - | - | - | - | - | - | 187.2 | - | 3.5 |
| | 2 | - | - | - | - | - | - | - | 4.5 | 11.1 | 126.8 | - | 5.7 |
| 2 | 3 | 0.1 | - | - | - | - | - | 6.0 | 1.0 | 8.0 | 25.4 | - | 3.5 |
| | 4 | - | - | - | - | - | - | - | - | 2.5 | 88.4 | - | 0.2 |
| 4 | 3 | - | - | - | - | 2.3 | - | - | 2.3 | 11.6 | 187.7 | - | 3.5 |
| | 4 | - | - | 2.2 | - | 13.3 | - | - | - | - | 111.6 | - | 7.9 |
| 5 | 1 | - | - | 4.3 | - | - | 0.3 | - | 4.3 | 34.4 | 412.1 | - | 7.1 |
| | 3 | - | - | 0.5 | - | 1.6 | - | - | 0.5 | 6.1 | 13.5 | 0.1 | - |
| 6 | 1 | - | - | - | - | 6.8 | - | - | 0.1 | 22.7 | 68.9 | - | 0.4 |
| | 4 | - | - | - | - | 8.4 | - | 8.4 | - | 4.2 | 48.1 | - | 11.5 |
| 7 | 1 | - | - | - | - | - | - | - | - | 38.3 | 143.6 | - | 0.5 |
| | 2 | - | - | - | - | 16.8 | - | - | - | 25.1 | 1910.3 | - | 0.1 |
| 8 | 1 | - | - | - | - | - | - | - | 9.7 | 13.4 | 418.5 | - | 0.3 |
| | 4 | - | 2.4 | - | - | 4.7 | - | - | - | 67.1 | 111.9 | 0.2 | 21.3 |
| 9 | 3 | - | - | - | - | 6.5 | - | - | 0.1 | 41.4 | 171.3 | - | 7.1 |
| | 4 | - | - | - | 0.1 | - | - | - | 0.1 | 6.8 | 54.6 | - | 12.1 |
| 10 | 3 | - | - | - | - | 16.1 | - | - | 0.1 | 16.1 | 594.4 | - | 0.1 |
| | 4 | - | - | - | - | 8.0 | - | - | - | 6.0 | 195.2 | - | 0.1 |
| 11 | 1 | - | - | - | - | - | - | - | 0.1 | - | 95.1 | - | 22.5 |
| | 3 | - | - | - | - | 6.3 | - | 2.1 | - | 16.8 | 134.7 | - | 0.5 |
| 12 | 3 | - | - | - | - | - | - | 4.6 | 6.5 | 15.2 | 41.1 | - | - |
| | 4 | - | - | - | - | - | 11.3 | 7.8 | 12.9 | 22.8 | 68.0 | - | 9.0 |
| 13 | 4 | - | - | 0.5 | - | 1.5 | - | 0.5 | - | 0.5 | 47.3 | - | 0.6 |
| | 5 | - | - | - | - | - | - | 0.1 | - | - | 1.9 | - | 0.1 |
| 14 | 2 | - | - | - | - | - | - | - | 0.1 | - | 68.2 | - | 1.1 |
| | 4 | - | 2.0 | - | - | 10.2 | - | - | 0.1 | 0.5 | 40.6 | - | - |

Table 7 continued…

| Set Code | Station | SIPH | TDIS | UCAL |
|---|---|---|---|---|
| 1 | 1 | 16.2 | 20.8 | - |
| | 2 | 0.6 | 10.4 | 5.2 |
| 2 | 3 | - | - | - |
| | 4 | - | - | - |
| 4 | 3 | 5.2 | 7.0 | - |
| | 4 | 2.8 | 4.4 | - |
| 5 | 1 | - | - | - |
| | 3 | 0.1 | - | - |
| 6 | 1 | 3.0 | - | - |
| | 4 | 0.3 | - | - |
| 7 | 1 | 0.1 | - | - |
| | 2 | - | - | - |
| 8 | 1 | 1.4 | - | - |
| | 4 | 0.1 | 26.8 | - |
| 9 | 3 | - | - | - |
| | 4 | 0.1 | 6.8 | - |
| 10 | 3 | 0.1 | 4.0 | - |
| | 4 | 0.1 | - | - |
| 11 | 1 | 0.2 | - | - |
| | 3 | 0.1 | - | - |
| 12 | 3 | - | - | - |
| | 4 | - | - | - |
| 13 | 4 | - | - | - |
| | 5 | 1.0 | - | - |
| 14 | 2 | 8.0 | - | - |
| | 4 | 3.3 | 1.7 | - |